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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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09 MANPOWER, GRANTS, AND FACILITIES

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SUBJECT INDEX

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGY OF MID-ALTITUDE TUSSOCK GRASSLANDS, UPPER WAIPORI CATCHMENT: II - WATER BALANCE, FLOW DURATION AND STORM RUNOFF,
New Zealand Forest Service, Rotorua. Forest Research Inst.
A. J. Pearce, L. K. Rowe, and C. L. O'Louglin.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 60-72, 1984. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Storm runoff, *Grasslands, *Hydrologic models, *Upper Waipori Catchment, *New Zealand, Flow, Rainfall, Vegetation, Interception, Transpiration, Groundwater storage, Quickflow.

Water balances over 3 years in two catchments in largely unmodified narrow leaved snow tussock indicate that evaporative losses are substantially smaller than would be predicted from Penman or other methods of estimation. Runoff, particularly delayed runoff, is high in comparison with other vegetative covers in either similar or substantially wetter rainfall climates. Interception losses, at about 20% of gross rainfall, are somewhat higher than anticipated for vegetation of this type and stature, and are comparable with scrub vegetation or low density forest stands. Transpiration on a daily, monthly, or annual basis, except in winter months, is much less than would be predicted by Penman's or Priestley and Taylor's equation. The low transpiration values are also consistent with the observed high, persistent rates of delayed runoff from shallow, unconfined groundwater storage, indicating that upward fluxes of soil water to transpiration do not compete effectively with drainage of the groundwater to delayed runoff. Storm runoff responses are moderate and are comparable to areas of indigenous forest with similar rainfall climates in terms of the ratio of quickflow to storm rainfall over a wide range of event sizes. Quickflow as a proportion of total runoff is less than in most areas studied in detail in New Zealand, but this reflects the persistence of high rates of delayed flow, rather than small yields of quickflow. A simple conceptual model of daily water balance with an interception store and regolith store discharged by transpiration and drainage is capable of fitting the major components of the water balance to a precision of better than 10%. This model, however, does not identify precisely the mechanisms by which either quick flow or delayed runoff are generated. (Baker-IVI)
W86-01384

CONCEPTUAL RUNOFF MODEL FOR A MOUNTAINOUS RAIN-ON-SNOW ENVIRONMENT, CRAIGIEBURN RANGE, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
R. D. Moore, and I. F. Owens.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 84-99, 1984. 6 Fig, 4 Tab, 22 Ref.

Descriptors: *Runoff, *Model studies, *Snow, *Rainfall, *New Zealand, *Craigieburn Range, Evaporation, Storm seepage, Air temperature, Estimating, Snowmelt, Wind.

A runoff model incorporating a distributed snow routine and a lumped transformation routine was developed for conditions in non-glacierized mountainous basins in the eastern South Island of New Zealand, and was applied in the Camp Stream catchment. A major problem was the overestimation of runoff. The magnitudes of the water-balance components in the South Island mountain regions, particularly evaporation and subsurface basin outflow, should be investigated to improve the model. Mean daily air temperature is inadequate for discriminating rain from snow at elevations lower than about 1500 m. Precipitation and temperature data with a resolution of three hours or less may be required to simulate snow accumulation. Further modelling work on this environment should include distributed transformation routines and the refinement of snowmelt indices. In particular, the use of alternative wind-speed indices, such as wind speeds from upper air-pressure, should be explored. (Baker-IVI)
W86-01386

RECURRENCE INTERVAL OF DROUGHT EVENTS THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Hydrological Sciences Journal, Vol. 30, No. 2, p 197-206, June, 1985. 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Drought, *Recurrence intervals, *Rainfall, *Streamflow, *Stochastic hydrology, *Victoria, *Australia, Temporal distribution, Model studies, Data interpretation.

The efficient management of an agricultural system or the operation of a water supply scheme requires knowledge about critical droughts, such as their length, severity and frequency of occurrence. Several theoretical distributions are fitted to drought events of up to one year's duration and the average recurrence intervals calculated. A methodology based on stochastically generated data is proposed and used to obtain the average recurrence intervals of events of duration longer than one year. These methods are applied to five river basins in Victoria, Australia. The accuracy of the method is dependent on the adequacy of the generating model. (Author's abstract)
W86-01444

PROBABILITY-DISTRIBUTED PRINCIPLE AND RUNOFF PRODUCTION AT POINT AND BASIN SCALES,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W86-01449

GENERATION OF DELAYED PEAKS IN STREAM DISCHARGE,
Oxford Univ. (England). Geography School.
T. P. Burt, and D. P. Butcher.
Journal of Hydrology, Vol. 78, No. 3/4, p 361-378, June, 1985. 13 Fig, 1 Tab, 25 Ref.

Descriptors: *Storm seepage, *Stream discharge, *Delayed peaks, Flood peaks, Computer models, Simulation, Slopes, Soil water, Rainfall, Runoff, England.

Where deep permeable soils overlie impermeable bedrock and where steep hillslopes border a narrow floodplain, subsurface stormflow dominates the hydrograph. In such cases delayed peaks in stream discharge may occur several days after rainfall, providing the major volumetric response and possibly also the highest peak discharge. The general occurrence of such delayed peaks is considered, making reference to field data from two small drainage basins in southwest England, and to the results of computer simulations using a distributed hillslope model. The importance of soil-water convergence into hillslope hollows is stressed. The relative roles of rainfall and antecedent soil moisture in controlling the size and timing of the delayed peak is discussed. The implications of the results for hillslope runoff modelling are briefly considered. (Author's abstract)
W86-01480

MACROSCOPIC ESTIMATION OF AVAILABLE WATER RESOURCES IN KAGOSHIMA PREFECTURE, JAPAN (IN JAPANESE),
Kagoshima Prefectural Office (Japan). Planning Dept.
Y. Osako, T. Tsuyuki, S. Koriyama, and K. Hyakumoto.
Reports of the Faculty of Science, Kagoshima University, No. 17, p 89-101, December, 1985. 5 Fig, 7 Tab, 8 Ref.

Descriptors: *Water resources, *Kagoshima, *Japan, *Hydrologic cycle, Groundwater, Surface water, Precipitation, Runoff.

Proper planning for the development and management of water resources requires the quantitative estimation of available water including surface and ground water. A method of macro-estimate of available water resources is presented using rainfall, streamflow and evaporation data accumulated by Kagoshima Weather Bureau and Kagoshima Prefectural Office. In general, precipitation minus evaporation equals streamflow plus percolation. As percolating ground water ultimately reaches streams, quantities of water resources or surface runoff are calculated by annual precipitation minus evapo-transpiration. Compared with measured stream flow data, those calculated figures are rather large. This is presumably due to the nonuniform distribution of precipitation by orographic effect. The average annual runoff coefficient of rivers in Kagoshima Prefecture is 0.65. To estimate the safe yield, the annual low precipitation and runoff data in 1942 are selected to be expected to occur once every ten years. Rivers in Kagoshima Prefecture can be classified into four types by unit flow states (illustrated in tables). Each type of rivers reflects the geologic conditions of their drainage basins. Rivers of type I are characterized by very stable flow states through the year. Pyroclastic flow deposits or so-called shirasu are widely distributed in the basin of rivers of type I. Under a natural flow state, ratios of quantities of available surface water to total runoff in each type of river are 48.0%, 34.0%, 24.0%, and 18.0% respectively. Calculated quantities of available water under a natural flow state in Kagoshima Prefecture are given. (Author's abstract)
W86-01604

MAXIMUM LIKELIHOOD PARAMETER ESTIMATION OF HYDROLOGIC SPATIAL PROCESSES BY THE GAUSS-NEWTON METHOD,
Iowa Inst. of Hydraulic Research, Iowa City.
P. K. Kitanidis, and R. W. Lane.
Journal of Hydrology, Vol. 79, No. 1/2, p 53-71, July, 1985. 2 Fig, 2 Tab, 26 Ref. Department of the Interior project CT 381702, NSF grant CME-8106577.

Descriptors: *Maximum likelihood, *Parameter estimation, *Hydrology, Mathematical studies, Spatial properties, Gauss-Newton method, Optimization.

The Gauss-Newton method for maximum likelihood (ML) parameter estimation of spatially correlated hydrologic fields is described with emphasis on computational aspects associated with its implementation. The essence of the Gauss-Newton method is that, for purposes of applying Newton's optimization method, the Hessian of the function to be minimized is replaced by its average value eliminating the need to calculate second derivatives. In ML estimation, the parameters are determined through minimization of the negative log-likelihood function and the average of the Hessian is known as the information matrix. The information matrix provides a lower bound to the covariance matrix of parameter estimation error. Methodologies to account for near-singular information matrix and to enforce lower or upper bounds in the parameters are described. A general method to eliminate the bias in covariance parameter estimates caused by unknown drift parameters is also presented. Some simple examples are presented to illustrate the potential advantages of Gauss-Newton. The conditions under which this method should perform well are also discussed. (Author's abstract)
W86-01656

CORRELATION BETWEEN SAMPLE FIRST AUTOCORRELATION COEFFICIENT AND EXTREME HYDROLOGIC RUNS,
George Washington Univ., Washington, DC. International Water Resources Inst.
V. Yevjevich, and J. T. B. Obeysekera.
Journal of Hydrology, Vol. 79, No. 1/2, p 171-186, July, 1985. 9 Fig, 9 Tab, 15 Ref. NSF grant CEE-8405289.

Group 2A—General

Descriptors: *Runoff, *Autocorrelation, *Hydrologic series, Drought, Hydrologic models, Water demand, Autoregression.

Differences between the annual runoff series, as the systems water supply and the annual output series, as the systems water demand, define various types of runs. The extreme runs of samples of these differences are positively correlated with the parameters of series dependence in general, and series first autocorrelation coefficient r1, estimated from these samples, in particular. This correlation is made between the estimated r1 and each of the three variables of sample extreme runs. These variables are defined as summations of n longest or largest positive and longest or largest negative sample extreme runs. The resulting regression equations of r1 versus these variables permit an alternative estimation of rho 1, if this estimate is needed for any purpose. As expected, these correlations are always positive and relatively high. To show how high these correlations are, two models are used to generate samples of different sizes with various population p1 values and to study the resulting correlation: (1) first-order autoregressive normal process; and (2) dependent lognormal process, obtained by the exponential transformation of the first-order autoregressive normal process. (Author's abstract)
W86-01666

WATERSHED COMPUTER MODELS,
Flaherty-Giavara Associates, New Haven, CT.
J. G. MacBroom.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 187-199, June, 1985. 4 Fig.

Descriptors: *Computers, *Model studies, *Watershed management, Simulation, Water supply development, Water resources, Water management, Reservoir operation.

Two types of computer models are described that are useful tools for analyzing water supply reservoirs and dams. The use of watershed computer models is of particular importance to water supply utilities that depend on surface water reservoirs for raw water, and who are responding to increased demand for dependable supplies. In addition, computer models are critical for evaluating low flow conditions downstream of reservoirs, hydropower potential at reservoirs, and dam safety. The first type discussed in a continuous simulation model that mathematically represents the flow and storage of water over an extended period of time and is commonly used to determine safe yields. The second model mathematically simulates a single rainfall event, and is typically used to evaluate flood flows and spillway capacity at dams. The watershed computer models represent a major improvement in the ability to plan, manage, and operate water supply reservoirs. The use of calibrated computer models is vital in gaining a better understanding of reservoir operations, limitations, and potential development of resources. (Baker-IVI)
W86-01754

DETERMINATION OF GROWING SEASON SOIL WATER DEFICITS ON A FORESTED SLOPE USING WATER BALANCE ANALYSIS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
D. G. Giles, T. A. Black, and D. L. Spittlehouse.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 107-114, February, 1985. 5 Fig, 4 Tab, 38 Ref.

Descriptors: *Soil water, *Soil moisture deficiency, *Forests, *Hydrologic budget, Slopes, Solar radiation, Air temperature, Rainfall, Root zone, Storage capacity, Elevation, Evapotranspiration.

Coefficients for the calculation of soil water balance components at seven sites on a forested slope were determined using only measurements of daily solar irradiance, maximum and minimum air temperature and rainfall, and weekly root zone soil water content during a 2-year period. Site parameters required were root zone depth, soil water retention characteristics, and rainfall interception coefficients. Based on daytime net radiation, the Priestley-Taylor evapotranspiration coefficient (alpha) was found to be 0.73 +/- 0.07, which is similar to values reported in other conifer forest studies. Growing season water deficit increased with decreasing root zone water storage capacity, which was mainly a function of root zone depth. A comparison between high and low elevations on the slope showed 100-year site indices ranging from 17 to 53 m corresponding to growing season soil water deficits during the driest year of the study, ranging from 79 to 4 mm. Basal area annual increments were found to be correlated with soil water deficits and growing season transpiration, both for the study period and when both variables were averaged over the last 18 years. (Author's abstract)
W86-01786

2B. Precipitation

CONCEPTUAL RUNOFF MODEL FOR A MOUNTAINOUS RAIN-ON-SNOW ENVIRONMENT, CRAIGIEBURN RANGE, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W86-01386

YEAR OF WORLD WIDE EXTREMES; FLOODS AND DROUGHTS,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Assessment Branch.
D. LeComte.
Weatherwise, Vol. 37, No. 1, p 8-11, 15-17 and 19, February, 1984. 10 Fig.

Descriptors: *Weather patterns, *Drought, *Floods, Rainfall, Storms, Climate, Heat, Cold, Monsoons, Hurricanes, Cyclones.

The year 1983 was a year of extremes - severe drought, heavy rains, extreme heat, unseasonable cold, the culmination of the El Nino event. Specific events cited in this review include the record floods in the California, Utah and Colorado areas, torrential rains in Ecuador, ferocious storms in winter and spring which swept eastward across the North Atlantic into northern Europe and Scandinavia, drought in southern Africa, fires brought on by extreme heat and drought in Australia, heavy rains later causing floods in the same areas, rivers flooding in South America, drought and heat in the United States and Europe, below normal rainfall in western and central Africa, monsoons in southeast Asia, heavy rains in Mexico and southern United States, hurricanes and cyclones, and record cold in November in the United States. (Baker-IVI)
W86-01427

UNEVEN PATTERN; THE 1982-83 SNOW SEASON,
D. M. Ludlum.
Weatherwise, Vol. 37, No. 1, p 20-23, February, 1984. 3 Fig.

Descriptors: *Weather, *United States, *Snow, Snow cover, Snow pack.

In the United States the snow season of 1982-83 was characterized by its uneveness. The most unusual early-season snowstorms occurred in central Wyoming where Lander measured a total of 32.9 inches, a new September record. The big snow scene in October shifted to the Black Hills of South Dakota. The heavy snow season got underway in November in the Sierra of California with 105 inches at Twin Lakes. El Paso recorded the most unusual December snows, with a total of 18.2 inches. Precipitation in New England was deficient, and January showed record warming trends in all the snow country. March of 1983 brought the biggest snows of the year to California and the season continued at a good rate into April. Very heavy wet snows fell at higher elevations of the West topped by a storm which left an estimated four feet in the Bearpaw Mountains of north central Montana. Winter totals for the Pacific Mountains included 707 inches at Twin Lakes, California, and 667 inches at Rainier Paradise, Washington. At Donner summit in the central Sierra, the season total exceeded all others in a record dating back to 1870. The snowpack disappeared at Crater Lake on July 22 after 270 days with 1 inch or more on the ground and at Rainier Paradise on July 25 after 280 days with snow cover. (Baker-IVI)
W86-01428

YEAR OF THE AFRICAN DROUGHT,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Assessment Branch.
D. LeComte.
Weatherwise, Vol. 38, No. 1, p 8-15, February, 1985. 12 Fig.

Descriptors: *Climatology, *Africa, *Sahel, *Drought, *United States, *Madagascar, *Philippines, *Korea, *Canada, *USSR, Cyclones, Flooding, Weather data collections, Weather patterns.

Although drought in Africa has not been unusual in recent years, during 1984 it covered an extraordinary area. Early in the year hot, dry weather cut crop production by one-half across the southern part of the continent. Later, during the (Northern Hemisphere) spring, one of the worst droughts of the century damaged food crops in East Africa. Finally, major drought during the summer affected Sahel zone agriculture, in west and central Africa. By the end of the year, the occurence of drought with other factors such as civil war and reduced food stocks had produced famine in at least three African countries and resulted in food shortages in nearly two dozen more. Highlights of weather extremes in other areas in 1984 included cold waves and storms early in the year in Europe and the United States, tropical cyclones hitting Madagascar, the Philippines, and the east coast of the United States, floods in Korea, and drought in Canada and the USSR. (Collier-IVI)
W86-01429

HEAVY IN THE WEST, LIGHT IN THE EAST: SNOWFALL IN 1983-84,
D. M. Ludlum.
Weatherwise, Vol. 38, No. 1, p 26-30, February, 1985. 7 Fig.

Descriptors: *Weather patterns, *Snow, *United States, Air temperature, Precipitation, Snow cover.

Very little snowfall was recorded during the first month of the 1983 snow season, September. Even October, being a very warm month, had only insignificant snowfalls. A crippling storm swept from the central Rockies to the western Great Lakes on Thanksgiving weekend and all of New England experienced a white Christmas with a moderate storm on the 22-23 of December. The first months of 1984 were very dry across the country with snowfall far below normal. Most areas of the country experienced unseasonably warm temperatures in February but March brought the greatest snow of the season to New England. Excessive amounts of snow also fell in an area across southern Montana and northern Wyoming and spread eastward into the Dakotas on April 25 to 28. In May only the western mountains witnessed any sizeable snowfalls. In June-July the snow cover at Berthoud Pass in Colorado dropped from 53 inches to bare ground by July 1. (Baker-IVI)
W86-01430

RECURRENCE INTERVAL OF DROUGHT EVENTS THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-01444

GENERALISED TECHNIQUE FOR THE ESTIMATION OF PROBABLE MAXIMUM PRECIPITATION IN INDIA,
Bureau of Meteorology, Melbourne (Australia).
P. R. Rakhecha, and M. R. Kennedy.
Journal of Hydrology, Vol. 78, No. 3/4, p 345-359, June, 1985. 10 Fig, 22 Ref.

Descriptors: *Probable maximum precipitation, *Estimation, Design floods, Rainfall, Rainstorms, Topography, Dew point, Mountains, Catchment area.

A version of a generalized method of estimating probable maximum precipitation (PMP) is applied to the catchments of four large dams in India. The value of a secure dam is high both in terms of human life and in economic terms. Reliable estimates of PMP are required in estimating the design flood for spillways of large earth and rockfill dams. Estimates of PMP obtained using the traditional method of moisture maximization and storm transposition can be unreliable as highly efficient rain storms may not be represented in the rainfall records of an area. Generalized methods of (calculating) PMP are used to obtain reliable estimates of PMP and also to give estimates which are consistent over a region. This is done by pooling together all the rainfall data from a very large area. The rainfall depths are normalized for such factors as storm dew-point temperature, distance of the storm from the coast, topographic effects and any intervening mountain barriers between the rainfall area and the moisture source. These normalized values can then be applied to any individual catchment, with the appropriate adjustment factors. (Author's abstract)
W86-01479

SOUTHERN OSCILLATION AND RAINFALL PATTERNS IN THE SOUTHERN HEMISPHERE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
R. G. Vines, and A. I. Tomlinson.
South African Journal of Science, Vol. 81, No. 3, p 151-156, March, 1985. 8 Fig, 36 Ref.

Descriptors: *Rainfall, *Southern Oscillation, *Southern Hemisphere, Rainfall distribution, Precipitation, Climatology, Sea surface temperatures, El Nino.

An index of the Southern Oscillation was examined in order to determine whether there were any connections between the Southern Oscillation and rainfall variations occurring in the southern hemisphere - particularly in the south Pacific region. When the results for the separate seasonal indices were compared, an interesting and striking observation was that there were only minor differences between the curves obtained in all four cases. Such an observation implies strong persistence of the Southern Oscillation from month to month. The present findings appear to substantiate commonly held ideas of a link between the behavior of the Southern Oscillation and rainfall variations in the southern hemisphere. Any such link no doubt depends on changes in atmospheric circulation and known connections between the Southern oscillation and fluctuations in sea-surface temperatures in the Pacific Ocean. On this basis, the out of phase relationship seen between the 6-7 year rainfall cycle in South America and elsewhere in the southern hemisphere from South Africa to Australia becomes understandable. This particular phenomeon is probably explainable in terms of El Nino events and the time lags involved in the movement of currents across the Pacific Ocean. (Baker-IVI)
W86-01497

DIURNAL VARIABILITY OF PRECIPITATION IN THE NORTHEASTERN UNITED STATES,
State Univ. of New York at Albany. Dept. of Atmospheric Science.
M. G. Landin, and L. F. Bosart.
Monthly Weather Review, Vol. 113, No. 6, p 989-1014, June, 1985. 28 Fig, 1 Tab, 19 Ref, 1 Append.

Descriptors: *Diurnal variation, *Precipitation, *Weather patterns, Probability, Seasonal variation, Rainfall distribution, New England, New York, New Jersey, Pennsylvania.

The diurnal and semidiurnal variations of precipitation over the northeastern United States (New England, New York, New Jersey and Pennsylvania) are investigated using 25 years of hourly precipitation data for 271 stations. The hourly data were harmonically analyzed for all measurable precipitation events ranging upwards to amounts < 10.0 mm. Additionally, a regional probability of precipitation analysis was performed for homogeneously grouped stations. The winter season (November-March) displays a general early-to-mid-morning diurnal maximum for all measurable precipitation events across the Northeast with a shift to just before noon southward into Pennsylvania. For heavier precipitation events, much of the region retains the morning maximum, a notable exception being the northern mountains of New York and New England, where there is a late-evening maximum. The spring (April-May) season is quite similar to winter, although the diurnal amplitudes become weaker everywhere except from southeastern Pennsylvania, up across the New York City metropolitan area, and into southern New England, where a stronger early-morning maximum appears. Evidence for nocturnal activity is seen across western New York and Pennsylvania in the heavier precipitation category, possibly in association with stagnating warm fronts that seldom move eastward due to cold air damming in New England. Summer (June-August) features a prominent diurnal cycle at most inland locations for all precipitation categories. A strong 1800 LST maximum exists in western Pennsylvania, with a trend towards a later maximum as one moves eastward towards southern New England. Coastal stations and those along the shores of Lakes Erie and Ontario show a tendency towards nocturnal precipitation, as there appears to be a suppression of daytime convection due to the cooler ocean and lake waters. The autumn (September-October) season displays a return to a weaker diurnal pattern, similar to spring. The morning maxima return to most places, except in the mountainous areas, where late season convection tends to peak in the afternoon. The semidiurnal cycle is weak across all seasons and tends to reflect the influence of local circulations. The regional probability of precipitation analysis reveals that much of the interior northeastern United States, with the exception of western and central Pennsylvania, has maxima centered at 0300, 1000 and 1800 LST for all measurable precipitation events during the cool season. These maxima appear to be the result of a blend of synoptic scale and mesoscale forcing involving phenomena peculiar to the local geography. During the spring and summer the afternoon convective signal is most strongly evident inland. It is especially pronounced in western Pennsylvania where a further nocturnal springtime maximum is seen. Finally, an analysis of precipitation by day of the week and by day of the lunar synodic cycle is presented. No concrete evidence is found to support either signal. (Author's abstract)
W86-01525

ROLE OF LIQUID WATER ON AN ICE SURFACE DURING RIMING ELECTRIFICATION - BASIC EXPERIMENT IN THUNDERSTORM ELECTRIFICATION,
Hawaii Univ. at Hilo. Cloud Physics Observatory.
For primary bibliographic entry see Field 2C.
W86-01528

EFFECTS OF DROP SIZE DISTRIBUTION TRUNCATION ON RAINFALL INTEGRAL PARAMETERS AND EMPIRICAL RELATIONS,
Clemson Univ., SC. Dept. of Physics and Astronomy.
C. W. Ulbrich.
Journal of Climate and Applied Meteorology, Vol. 24, No. 6, p 580-590, June, 1985. 9 Fig, 20 Ref.
National Science Foundation grant ATM-8120686.

Descriptors: *Rain, *Drop size distribution, *Fluid drops, Statistical analysis, Disdrometers, Numerical analysis.

A description is given of a method of estimating the effects of truncating the raindrop size distribution (DSD) at lower and upper drop diameters D min and D max which assumes that the DSD can be approximated by a gamma distribution (including the exponential distribution). The method is used to investigate the effects of DSD truncation on rainfall integral parameters (e.g., reflectivity factor, liquid water content, etc.) and on empirical relations between pairs of these integral parameters. Tests of the theoretical predictions are performed using a set of drop size data collected with a Joss disdrometer. A brief description is also given of the use of the method to determine DSD truncation effects on precipitation parameters deduced from dual-measurement techniques. (Author's abstract)
W86-01534

FRACTAL PROPERTIES OF RAIN, AND A FRACTAL MODEL,
Etablissement d'Etudes et de Recherches Meteorologiques, Paris (France).
S. Lovejoy, and B. B. Mandelbrot.
Tellus, Vol. 37A, No. 3, p 209-232, May, 1985. 18 Fig, 1 Tab, 36 Ref.

Descriptors: *Fractals, *Rainfall, *Model studies, Simulation, Probability, Statistical studies, Spatial distribution, Temporal distribution, Rainfall distribution.

This paper amplifies upon earlier theories and observations by the authors, advances a probabilistic model of rain fields, and exhibits realistic simulations. The model is also compared with other approaches. The theory of fractals has been in part motivated by the Hurst effect, which is an empirical observation in hydrology and climatology. A fractal is an unsmooth shape that is scaling, that is, where shape appears unchanged when examined by varying magnifications. The study of fractals is characterized by the prevalence of hyperbolically distributed random variables, for which $Pr(U > u)$ varies directly as u to the -alpha where Pr is the probability that the value of the variable exceeds u, and alpha is a positive exponent. Lovejoy established the applicability of fractals in meteorology, by showing that cloud and rain areas project on the Earth along shapes whose boundaries are fractal curves, and that the temporal and spatial structure of rain is rife with hyperbolically distributed features. These observations, as amplified in this paper, set up the challenge of constructing fractal models with the observed properties. The models presented here belong to a very versatile family of random processes devised in Mandelbrot: fractal sums of (simple) pulses, or FSP processes. The simulations to be presented reveal that these processes involve a scaling heirarchy of 'bands', 'fronts', and 'clusters', as well as other complex shapes, none of which had been deliberately incorporated in the process. This very rich morphology and the related statistical distributions exemplify the power of simple fractal models to generate complex structures, and are in accord with the wide diversity of actual rainfall shapes. It is argued that this model already provides a useful context in which the basic statistical properties of the rainfield, including the relationship between the temporal and spatial structure, may be studied. (Author's abstract)
W86-01749

SENSITIVITY OF AN ENERGY BALANCE CLIMATE MODEL WITH PREDICTED SNOWFALL RATES,
National Oceanic and Atmospheric Administration, Princeton, NJ. Geophysical Fluid Dynamics Lab.
K. P. Bowman.
Tellus, Vol. 37A, No. 3, p 233-248, 1985. 10 Fig, 2 Tab, 28 Ref, 1 Append.
NSF grant ATM 8106800.

Descriptors: *Climate, *Energy balance, *Model studies, *Snowfall, Snow cover, Ice sheets, Solar radiation, Hydrologic cycle, Temperature, Water vapor, Atmospheric transport.

A two-level zonally-averaged seasonal energy balance model with separate land and ocean temperatures and an explicit surface energy budget is used

to study the effects of the snowfall rate of the extent of snow cover and ice sheets. Sensitivity experiments are performed both with and without ice sheets and with two different snowfall parameterizations. When snowfall rates are prescribed independent of latitude, higher snowfall rates increase the area of snow cover but reduce the sensitivity of the snow line to changes of the solar constant. To eliminate arbitrary assumptions about the snowfall rate, a relationship between the atmospheric transports of water vapor and sensible heat is derived and tested against observations. The relationship obtained is used to predict the meridional transport of water vapor in the model, from which the precipitation and snowfall are calculated. The response of the hydrologic cycle to changes of the solar constant is qualitatively similar to that found in general circulation models. The snow line is more sensitive with the predicted precipitation than with the prescribed precipitation because the predicted precipitation rate increases toward the equator. When ice sheets are included, they are larger than permanent snow cover under the same conditions because the cold surface temperatures at high elevations on the ice sheet inhibit melting. Feedback effects of the ice sheets are small, in part because they are limited to 30% of a latitude circle in this model. (Author's abstract)
W86-01750

GLOBAL STATUS AND TREND OF DESERTIFICATION,
United Nations Environment Programme, Nairobi (Kenya). Desertification Branch.
G. Karrar, and D. Stiles.
Journal of Arid Environments, Vol. 7, No. 4, p 309-312, 1984. 2 Fig.

Descriptors: *Desertification, *Drought, *International commissions, United Nations, Foreign aid, Erosion, Land use, Planning, Rainfall, Irrigation, Developing countries, Political aspects, Organizations.

Drylands are presently under stress to a degree perhaps unprecedented in history. High human and livestock populations growth, chronic drought and bad land-use practices in many areas have resulted in 75% of all the productive land within the world's drylands becoming desertified to some extent. A United Nations Conference on Desertification in 1977 formulated the Plan of Action to Combat Desertification (PACD). On all fronts, desertification has worsened since the conference. Land irretrievably lost to desert continues at 60,000 sq km/yr, while land rendered economically unproductive is showing an increase at 210,000 sq km/yr. Most responsibility for implementing the PACD at the national level rests with governments. UNEP (United National Environment Program) hoped to use the occasion of the 12th Governing Council and the presentation of the Executive Director's report on the General Assessment to stimulate renewed interest in the global problem of desertification. It is a problem which needs immediate, concentrated attention by the world's governments and international organizations. (Baker-IVI)
W86-01855

INCIDENCE OF DROUGHTS AND ITS IMPACT ON FOOD PRODUCTION IN RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India).
G. G. S. N. Rao, Y. S. Rama Krishna, B. V. Ramana Rao, and R. S. Purohit.
Annals of the Arid Zone, Vol. 23, No. 4, p 327-334, 1984. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Drought, *Crop yield, *Rajasthan, *India, Monsoons, Millet, Pulses, Rainfall, Aridity index.

Failure of the monsoon rains leading to drought conditions is common in Rajasthan State, India. The incidence and spread of drought over Rajasthan during the years 1972, 1974 and 1979, were analyzed on the basis of departures from the normal aridity index during different months of the southwest monsoon season. District averages of monthly rainfall for all the 26 districts in Rajasthan State were obtained from the daily rainfall records. The average rainfall in the State decreased by 32, 18 and 7% during the drought years 1972, 1974 and 1979, respectively. Consequently 84, 68 and 86% of the total area was affected by drought in the respective years. Productivity of pearlmillet and pulses was considerably affected by drought conditions. The impact of drought on the fall in productivity of these crops is more pronounced in western Rajasthan than in eastern Rajasthan. The decrease in yields during the three drought years varied from 61 to 92% in pearlmilet and 71 to 86% in the pulse crop. The variations in the productivity of the rainfed crops can be explained satisfactorily by the pattern of incidence and the spread of droughts. (Moore-IVI)
W86-01856

2C. Snow, Ice, and Frost

MODELLING ALPINE SNOW ACCUMULATION AND ABLATION USING DAILY CLIMATE OBSERVATIONS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
R. D. Moore, and I. F. Owens.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 73-83, 1984. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *New Zealand, *Model studies, *Snow, *Ablation, Alpine regions, Air temperature, Mountains, Simulation, Precipitation, Altitude.

Modelled snow storage is compared to data from a snow course in the Craigieburn Range, and the utility and limitations of this approach are assessed for New Zealand conditions and data availability. Low-altitude precipitation measurements appear to provide a good index of high-altitude precipitation when averaged over the accumulation season. Snow storage was reasonably reproduced when temperatures measured at a site above the seasonal snow-line were used. The simulation quality was less satisfactory when low-altitude temperatures were used, because of marked and systematic deviations of the actual from the assumed lapse rate, and the consequent problem of distinguishing rain from snow. If no high altitude temperature measurements are available, the use of observations of storm snow-line elevations to determine the phase of precipitation may improve simulation quality. Application of these approaches should help to overcome lack of data on snow accumulation in mountainous areas of New Zealand. (Baker-IVI)
W86-01385

UNEVEN PATTERN; THE 1982-83 SNOW SEASON,
For primary bibliographic entry see Field 2B.
W86-01428

INTERNATIONAL PERSPECTIVE ON LARGE-SCALE SNOW STUDIES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
A. Rango.
Hydrological Sciences Journal, Vol. 30, No. 2, p 225-238, June, 1985. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *International commissions, *Snow, *Large scale studies, *Research priorities, Precipitation, Remote sensing, Policy making, Governmental interrelations, Political aspects.

Because of significant physical differences between snow and other naturally occurring substances, snow is not only a valuable resource but it also has significant large-scale effects on weather, climate and the hydrological cycle. A working group of the IAHS International Comission on Snow and Ice (ICSI) has recently reached certain conclusions regarding these effects. In order to study and model the large-scale effects of snow, the standardization of existing ground observation methods, the exploitation of new technologies such as remote sensing, and the systematic archiving of all data are necessary. Various research efforts and international activities have been identified which, when accomplished, should lead to improved understanding and management of the large-scale effects of seasonal snow cover. An international organization should take the lead in promoting an exchange of ideas, techniques, measurements, research results and management strategies on large-scale snow studies. (Author's abstract)
W86-01446

ROLE OF LIQUID WATER ON AN ICE SURFACE DURING RIMING ELECTRIFICATION - BASIC EXPERIMENT IN THUNDERSTORM ELECTRIFICATION,
Hawaii Univ. at Hilo. Cloud Physics Observatory.
T. Takahashi.
Journal of the Meteorological Society of Japan, Vol. 63, No. 2, p 262-266, April, 1985. 3 Fig, 15 Ref.

Descriptors: *Electrification, *Ice, *Rime, Temperature effects, Clouds, Thunderclouds, Electrical properties, Hail, Snow, Thunderstorms.

Since the surface potential of liquid water on an ice surface is negative, the negative space charge will be enriched in the liquid layer. When this negative charge liquid layer is torn off as ice crystals collide and separate, a positive charge will be measured on rime. The present study examines this phenomenon in the cold room. At warm temperatures or in regions where the cloud water content is very high, graupel (or hail) may be electrified positively if the water film on the ice surface is removed by ice crystals when they collide and separate. If the contact area is 10 micro-m x 100 micro-m, the separated charge during such a process will be on the order of 10 to the minus 5 power esu, which is similar to the order of magnitude observed during riming. At colder temperatures, except in regions where the water content is very high, charge separation will be associated with the defects which form during ice fracture if this occurs in a graupel growth stage. Under hail growth conditions in colder temperatures, hail may be electrified during either dropsplashing or ice crystal contact-separation while liquid water flows over the hail surface. The chemical impurities of water will determine the polarity of the charge which is separated. In the latter case, the detachment of water may not be necessary for charge separation. (Baker-IVI)
W86-01528

SENSITIVITY OF AN ENERGY BALANCE CLIMATE MODEL WITH PREDICTED SNOWFALL RATES,
National Oceanic and Atmospheric Administration, Princeton, NJ. Geophysical Fluid Dynamics Lab.
For primary bibliographic entry see Field 2B.
W86-01750

ICE STORM DAMAGE TO A SOUTHERN WISCONSIN MESIC FOREST,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
L. P. Bruederle, and F. W. Stearns.
Bulletin of the Torrey Botanical Club, Vol. 112, No. 2, p 167-175, April-June, 1985. 1 Fig, 4 Tab, 33 Ref.

Descriptors: *Ice storms, *Storm damage, *Forests, *Wisconsin, Litter, Canopy, Wind, Topography, Climate, Slope, Glaze, Elm trees, Ironwood trees.

In 1976, an extensive ice storm struck southern Wisconsin, resulting in substantial damage to the upland forest at the University of Wisconsin-Milwaukee Cedar-Sauk Field Station. Strong northeasterly winds following the storm (80.6 km/hour) exacerbated the damage. A forest fuel sampling technique was modified to measure the volume of macro-litter resulting from the ice storm. The canopy was photographed using both wide-angle and fish-eye lenses to determine the effect upon the overstory. Macro-litter volume was determined to be 19.35 cu m/ha, accounting for a loss of approximately 35% of the canopy. Damage was uneven and was influenced by topographic and climatic

factors; inclination and aspect of slope, as well as wind were found to be of particular importance. Species susceptibility to glaze varied considerably. Susceptibility was quantified by preparing a ratio of the observed macro-litter volume with the expected volume based upon the relative dominance of each species in the stand. Ratio products ranged from 1.55 for Ulmus rubra, the most susceptible species, to 0.17 for Ostrya virginiana. Factors responsible for species susceptibility include growth form, mechanical properties of wood, tree age and degree of decay, and position in the canopy. (Author's abstract)
W86-01760

SAMPLING OF SNOW AND ICE ON LAKES,
Trent Univ., Peterborough (Ontario). Dept. of Geography.
W. P. Adams, and N. T. Roulet.
Arctic, Vol. 37, No. 3, p 270-275, September, 1984. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Ice, *Snow, *Lake ice, *Elizabeth Lake, *Labrador, White ice, Black ice, Lakes, Snow cover, Seasonal variation.

Three years of data were collected on the late winter snow and ice cover of Elizabeth Lake, Labrador, with a view to developing practical and effective sampling procedures for snow and ice on lakes in general. Elizabeth Lake has an area of 11.08 ha, a mean/maximum depth of 8.7 m/27.1 m and a volume of 2.45 x 10 to the 6th power cu m. The variation between years in mean cover values was not large. Mean snow depth varied most between years, and total ice cover the least. Black ice is lake water frozen in situ, while white ice is formed following the slushing of a snow cover. In terms of distribution present on the lake at the time of the surveys, white ice consistently had the highest coefficient of variation, with total ice again having the lowest. The pattern for black ice forms an interesting reversal of the white ice pattern with thinner ice around the margins and downwind. This illustrated that these two types of ice tend to be compensatory. (Baker-IVI)
W86-01788

2D. Evaporation and Transpiration

HYDROLOGY OF MID-ALTITUDE TUSSOCK GRASSLANDS, UPPER WAIPORI CATCHMENT: II - WATER BALANCE, FLOW DURATION AND STORM RUNOFF,
New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 2A.
W86-01384

DIFFERENTIAL EVAPO-TRANSPIRATION FROM A CLAY SURFACE AND ITS INFLUENCE ON EQUILIBRIUM POREWATER PRESSURE,
Golder Associates, Maidenhead (England).
For primary bibliographic entry see Field 2G.
W86-01451

ESTIMATION OF EVAPORATION FROM THE NORMALLY 'DRY' LAKE FROME IN SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison, and C. J. Barnes.
Journal of Hydrology, Vol. 78, No. 3/4, p 229-242, June, 1985. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Lake Frome, *South Australia, *Dry lakes, *Evaporation, Groundwater inflow, Saline water, Deuterium, Recharge.

Lake Frome, situated in northern South Australia, contains water only rarely, the last time being in the period 1973-74. Depth profiles of deuterium composition, expressed as delta-values, have been used to make point estimates of evaporation from the floor of the normally 'dry' Lake Frome. Values from five sites, varying between 90 and 230 mm/yr, have been used to obtain a relatively crude approximation for mean evaporation rate from the lake of 170 mm/yr. This estimate is lower than would be expected at first sight for an almost saturated sediment surface with a water table at about 300 mm in an environment where the evaporation rate from a Class A pan is 3200 mm/yr. Actual evaporation is reduced well below potential because the vapor pressure deficit between the atmosphere and water at the evaporating surface is reduced because this water is saturated with sodium chloride. Because the surface is almost white, it has an albedo much higher than that of a free-water surface. The total evaporative flux from the lake is estimated to be 4.6 x 10 to the 8th power cu m/yr. In periods of no surface water inflow to the lake this represents the groundwater inflow to the lake. Under steady state conditions, and assuming that the surface catchment and the groundwater catchment are identical, this corresponds to a mean recharge flux of about 1 mm/yr over the catchment. (Moore-IVI)
W86-01471

DIFFERENCES IN ANNUAL EVAPORATION BETWEEN GRAZED PASTURE AND EUCALYPTUS SPECIES IN PLANTATIONS ON A SALINE FARM CATCHMENT,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
E. A. N. Greenwood, L. Klein, J. D. Beresford, and G. D. Watson.
Journal of Hydrology, Vol. 78, No. 3/4, p 261-278, June, 1985. 8 Fig, 4 Tab, 5 Ref.

Descriptors: *Evaporation, *Eucalyptus trees, *Pastures, *Australia, Saline seeps, Leaf area, Interception, Stem flow, Land reclamation, Saline farm land.

Daily evaporation (including evaporation from the ground surface) from grazed annual pastures and from five species of Eucalyptus in two farm plantations (in Australia) was measured at regular intervals for a year. Leaf area of trees and pasture, and rainfall interception and stem flow by trees, were also measured. The trees were in their seventh year after germination. The site was a first-order catchment that had developed a saline seep midslope after the felling of the prior forest. One plantation was upslope, the other was immediately above the seep. The work is part of a salinity reclamation study based on increased evaporation through the strategic use of trees. Annual evaporation from pastures was 390 mm regardless of position in the landscape. Annual evaporation from trees upslope was 2300 mm for Eucalyptus maculata and 2700 mm each for E. globulus and E. cladocalyx. Values at midslope were 1600 mm for E. wandoo, 1800 mm for E. leucoxylon and 2200 mm for E. globulus. Expressed as a proportion of annual rainfall (680 mm), annual evaporation was 0.6 for pasture and ranged from 2.4 to 4.0 for trees while interception by trees ranged from 0.16 to 0.36, and stem flow was less than 0.02. Annual evaporation, but not interception, was correlated with leaf area. The application of these findings is discussed. It is concluded that the planting of discrete areas of trees has the evaporation potential to assist in reclamation of saline farm land in the southwest region of Australia and that some species are much more effective than others. (Author's abstract)
W86-01473

SIMPLIFIED PROCEDURE FOR THE EVALUATION OF THE LAKE KINNERET EVAPORATION,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
E. Simon, and F. Mero.
Journal of Hydrology, Vol. 78, No. 3/4, p 291-304, June, 1985. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Lake evaporation, *Lake Kinneret, *Israel, Hydrologic budget, Energy balance, Mass transfer, Meteorology, Air temperature, Water temperature, Evaporation.

Actual evaporation losses from lake surfaces can still not be determined by direct measurements. This presents a major problem to the planners, especially in cases as Lake Kinneret (Israel), where evaporation losses represent about 30% of its water budget. A description is given of the various approaches to find an optimal method for the quantitative estimation of evaporation losses from this lake, to enable reliable water-budget calculations and also to serve as a tool for the various water allocation models for long-range planning, now under development. Past experience shows that the best evaporation estimates can be obtained by the energy balance and the mass transfer methods, widely used all over the world. In this case, two micro-meteorological stations were installed on the up-wind western and the down-wind eastern shore of the lake. The big mass of the accumulated data has been carefully analyzed, and served as a basis for the various theoretical and more or less empirical approaches to obtain the desired optimal estimate of lake evaporation losses. Another problem to be solved was to find simpler, more easily obtainable data (as air and water temperatures, etc.), to serve as long-term evaporation estimator, to permit reconstruction of long-term series of Lake Kinneret water balances, to permit optimized use of the available water resources originating from the Jordan River and the direct drainage area of this lake. The various estimation methods, discussed in this paper were calibrated and compared to the now used energy balance method, considered as the most reliable approach for the evaporation measurements. During the process of these analyses, some doubts were raised as to the reliability of frequently used methods for the elusive estimate of evaporation losses. (Author's abstract)
W86-01475

CALCULATING THORNTHWAITE AND MATHER'S ACTUAL EVAPOTRANSPIRATION USING AN APPROXIMATING FUNCTION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. Pastor, and W. M. Post.
Canadian Journal of Forest Research, Vol. 14, p 466-467, 1984. 1 Fig, 6 Ref. DOE contract W-7405-eng-26.

Descriptors: *Evapotranspiration, *Water loss, *Soil water, Precipitation, Temperature effects, Water storage.

Soil water storage is related to a maximum storage value (field capacity) and accumulated potential water loss through a simple negative exponential function. This formula summarizes 10 tables from the Thornthwaits and Mather (Publications in Climatology, 10: 183-311, 1957) needed to calculate actual evapotranspiration. Values predicted by this formula and the Thornthwaite and Mather's tabulated values are compared. Discrepancies between tabulated and predicted values occurred largely due to the fact that the equation is a continuous function while the tables are step functions. (Baker-IVI)
W86-01780

2E. Streamflow and Runoff

SOUTHLAND FLOOD OF JANUARY 1984,
Southland Catchment Board, Invercargill (New Zealand).
D. C. Riddell.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 120-129, 1984. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Rainfall, *Southland, *New Zealand, *Waihopai River, *Floods, Storm runoff, Water levels, Probable maximum precipitation, Flood hydrographs, Flood flow.

Nine automatic raingauges and more than 100 manual gauges gave an excellent record of the storm rainfall which caused the floods of January 1984 in Southland and caused extensive damage. River flows and lake levels were recorded at 17 sites. Over the 18 hours which the storm lasted, heavy rainfall was associated with fronts in an extremely deep and humid northwesterly airflow. The estimated probably maximum flood for the

Waihopai River which flows through Invercargill is twice the size of the January 1984 flood which reached 112 times mean flow. Being far larger than any other storm experienced in recent times, the 1984 storm provided an opportunity for assessing the likely probable maximum precipitation for the Invercargill region and particularly for the Waihopai River catchment. Temporal distribution of the January 1984 storm rainfall was similar to that normally assumed for the probable maximum precipitation, so a probable maximum flood hydrograph for the Waihopai River was derived by scaling the ordinates of the January flood hydrograph by the ratio of the probable maximum direct runoff to the January runoff. If 10% of the probable maximum precipitation were retained in storage, a direct runoff of 21 mm would be expected. This is twice the January 1984 flood runoff. With baseflow this would result in a probable maximum peak flow of 580 cu m/sin the Waihopai River, a specific discharge of 3.6 cumecs per square kilometer. (Baker-IVI)
W86-01388

DRAINAGE COEFFICIENTS FOR HEAVY LAND,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W86-01431

PROBABILITY-DISTRIBUTED PRINCIPLE AND RUNOFF PRODUCTION AT POINT AND BASIN SCALES,
Institute of Hydrology, Wallingford (England).
R. J. Moore.
Hydrological Sciences Journal, Vol. 30, No. 2, p 273-297, June, 1985. 10 Fig, 33 Ref.

Descriptors: *Statistical analysis, *Runoff forecasting, *Hydrologic models, *Rainfall-runoff models, Infiltration capacity, Storage capacity, Overland flow.

The probability-distributed principle in basin-scale hydrology considers the frequency of occurrence of hydrological variables (model inputs, parameters or elements) of certain magnitudes over the basin without regard to the location of a particular occurrence within the basin. The random assemblage of different parts is considered more important than the relation of the parts, one to another. Rainfall-runoff models based on probability-distributed infiltration capacity and storage capacity concepts, and which generate runoff according to Hortonian and saturation overland flow mechanisms respectively, are distinguished. Two types of probability-distributed storage capacity model are identified, one based on an assumption that storage elements at points in the basin respond independently of their neighbors, and the other where storage elements interact so as to equalize the depth of stored water over the basin. Allowing redistribution of water leads to simplification of the model equations. The probability-distributed principle is also used to represent the process of water translation through the basin. Interpretation of the instantaneous unit hydrograph as a probability density function of translation time is demonstrated and the inverse Gaussian density proposed as a suitable functional form on physical grounds. (Author's abstract)
W86-01449

RIVER RECESSION ANALYSIS IN THE OPERATIONAL MANAGEMENT OF LAKE ABSTRACTION,
S. Walker, and D. Pearson.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 244-253, June, 1985. 7 Fig, 4 Ref.

Descriptors: *Water level fluctuations, *Lakes, *Water management, Mathematical equations, Water level, Forecasting, Stream flow, Rivers.

The need to obtain reliable estimates of the likely changes in stream flow with time has led to a reappraisal of the methods available for analyzing flow data. The need also to include a stochastic component in the description of the way in which such data arise leads to some problems, but the developed techniques have been found to provide a reasonable solution to them. The methods are attractive, as they make no assumptions about the relationship between successive daily flows and hence may be applied in a wide range of situations. Some care is required when analyzing data with a high level of observational noise and for which recession rate varies markedly with flow. The search for more flexible techniques was justified by the analysis of flow data from Windermere and Ullswater. Here, recession rate varied with flow, and the relationship between them was different with and without abstractions. Changes in recession rate with flow were also observed on the river Derwent, though these were of a smaller order than those observed on the rivers controlled by lakes. A comparison between the recession curve for the unregulated flow in the river Derwent and the curves for Windermere and Ullswater in the no-pumping case is presented. The curves for Ullswater and the Derwent are similar, showing a steady quickening of recession rate as flow increases. This is the shape which can be expected for an uncontrolled river. In comparison, the curve for Windermere is much flatter. This is reasonably explained by difference in physical characteristics of the outlets to the lakes. The recession curves for Windermere have been used to construct a diagram showing the number of days for which pumping is likely to be sustained before the flow falls below a prescribed flow level. This is now being used as an aid in the everyday operation of the pumping station, and proves a practical example of the value of obtaining reliable estimates of recession factors for use in the management of lake and river abstraction systems. (Baker-IVI)
W86-01522

TURBULENT FLOWS OVER A WAVY BED,
Delaware Univ., Newark. Ocean Engineering Program.
N. Kobayashi, and O. S. Madsen.
Journal of Geophysical Research, Vol. 90, No. C4, p 7323-7331, July, 1985. 3 Fig, 1 Tab, 24 Ref.

Descriptors: *Turbulent flow, *Wavy beds, *Hydrodynamic models, Model studies, Shear stress, Boundary conditions, Ripples, Hydraulics, Hydrodynamics, Fluid mechanics.

A hydrodynamic model was developed for the calculation of shear stress and pressure along a sinusoidal boundary that is fixed or propagating very slowly in a wide rectangular open or closed channel. The model uses curvilinear coordinates that follow the wavy boundary, and it is similar to that for two-dimensional wavy boundary flows of infinite extent proposed by Benjamin except that the present model takes account of turbulent stresses on the basis of the turbulent eddy viscosity concept employed by Hussain and Reynolds. The compact analytical expressions for the perturbed shear stress and pressure on the wavy boundary are derived for the cases of hydraulically smooth turbulent and fully rough turbulent flows. The developed model is shown to be in good agreement with the experiments conducted by Zilker et al. The developed hydrodynamic model is applied to the problem of the formation of ripples in erodible channels by Kobayashi and Madsen. (Author's abstract)
W86-01537

TRAPEZOIDAL CHANNELS WITH INCREASING DISCHARGE,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
R. Guarga, and M. Lara.
Journal of Engineering Mechanics, Vol. 110, No. 7, p 1050-1059, July, 1984. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Trapezoidal channels, *Channel flow, *Stream discharge, Hydraulics, Cross-sections, Numerical analysis, Mathematical equations.

Flow in channels of trapezoidal section has not been treated in general, although it is the most frequent encountered in practice; there has also not been a complete review of the possible cases of flow in a channel of trapezoidal section with increasing flow. Previously, the solution to the problem of increasing discharge in trapezoidal cross sectional channels has been obtained via numerical computation for each particular case. The problem was studied using the classic equation of 'momentum' which is normalized utilizing the coordinates of the singular point. Using linear transformations it is possible to reduce the classic equation for channels with increasing discharge to a universal equation for all the cases of trapezoidal section and non-zero slope. The possible flow cases in a channel with increasing discharge arise from the analysis of this equation. In the case of a channel with zero slope, the exact solution to this problem is obtained by analytical integration of the equation for the adimensional parameters. It was possible to completely analyze different flow regimes that may occur in the channel and also the curves representing the free surface may be classified. (Collier-IVI)
W86-01541

STORMWATER RUNOFF FROM HIGHWAYS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5B.
W86-01605

NUTRIENT RUNOFF LOSSES AS PREDICTED BY ANNUAL AND MONTHLY SOIL SAMPLING,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W86-01709

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. R. Richardson, S. R. Abt, and E. V. Richardson.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1133-1147, August, 1985. 8 Fig, 3 Tab, 11 Ref.

Descriptors: *Inflow seepage, *Channels, *Streambeds, Seepage, Hydraulics, Sediment transport, Scour, Fluid dynamics.

A flume study was conducted to identify and analyze the effects of inflow seepage on flow in straight alluvial open channels. The effect of inflow seepage on energy slope, water surface depth, velocity, sediment transport, scour, bed forms, and resistance to flow was investigated. The results of this investigation indicated that inflow seepage increases localized mean channel velocity, energy slope, and stream power in the zone of inflow. The water surface depth decreased for subcritical flow and remained nearly constant for supercritical flow during inflow conditions. Sediment transport was slightly increased when inflow was introduced in the bed. Inflow seepage did not appear to enhance channel scour. Inflow seepage significantly enhanced bed form transformation and the bed roughness. Inflow seepage also caused dunes to become longer, flatter, and move more erratically in the reach where inflow occurred. Inflow seepage could significantly influence the channel hydraulics, stream power, bed form and bed roughness in the localized zone of inflow. (Author's abstract)
W86-01731

DETERMINATION OF RIPPLE GEOMETRY,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
M. S. Yalin.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1148-1155, August, 1985. 4 Fig, 10 Ref.

Descriptors: *Ripple geometry, *Ripple marks, *Streambeds, Sediment transport, Hydraulics, Fluid mechanics.

Laboratory measurements were carried out on the mobile bed covered by ripples generated by an open channel flow. The bed materials used were

cohesionless and reasonably uniform; the steady-state subcritical flume flow was in equilibrium and it was nearly two-dimensional. In addition to the conventional runs conducted with water, special runs were conducted with a water and glycerine mixture. Using the results of these measurements, as well as the data of other reliable sources, a series of experimental curves were determined which can be used to predict the length and height of ripples. The analysis of the data indicates that the dimensionless quantities related to the geometry of ripples are functions of two dimensionless variables. One of them must be a combination reflecting the intensity of sediment-transporting flow, the other must be an arrangement of parameters characterizing the physical nature and the liquid and solid phases involved. (Author's abstract)
W86-01732

PREDICTION OF 2-D BED TOPOGRAPHY IN RIVERS,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W86-01734

COMPARISON OF THE RESULTS OF CALCULATING UNSTEADY FLOW IN THE ENISEI MOUTH STRETCH BY THE FINITE-DIFFERENCE AND FINITE-ELEMENT METHODS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. K. Kantorovich, and T. A. Lysenko.
Water Resources, Vol. 11, No. 4, p 289-293, July-August, 1984. 3 Fig, 2 Tab, 4 Ref. Translated from Vodnye Resursy, No. 4, p 30-34, July-August, 1984.

Descriptors: *Unsteady flow, *Finite element method, *Enisei River, *USSR, Flow, Hydraulics, Waves, Wind, Surges, Computers.

The mouth stretch of the Enisei River (USSR) was investigated between Selivanikha and Baikalovsk, having a length of about 800 km. The upriver propagation of a surge wave forming within the Kara Sea and Enisei Gulf was investigated in this stretch. The formation of the surge is due to the presence of aperiodic fluctuations of the water level in the mouth nearshore zone occurring under the effect of wind and causing a variable backwater. As the initial information for assigning the hydraulic and geometric characteristics of the channel of the Enisei mouth region in the calculations, the data was used of hydrometric and morphometric measures which were preliminarily corrected with consideration of an analysis of the results of a number of calculations of the propagation of surges in 1962, 1963, 1969, 1972, and 1973. Calculation by the finite-difference method was performed on a BESM-6 computer according to a program written in ALPHA-6. Although the computers and translators used are different, an estimate made of the expenditures of computer time permits the conclusion that these expenditures are slightly less for calculation by the finite-element method. The calculations of unsteady flow by Saint Venant equations showed that for such a large scale object as the mouth stretch of the Enisei River the use of the finite-element method leads to some gain in accuracy and expenditures of computer time compared with the finite-difference method. (Baker-IVI)
W86-01802

TEMPERATURE REGIME IN WATER BODIES OF THE VOLGA DELTA UNDER REGULATED RUNOFF CONDITIONS,
Astrakhan Reserve (USSR).
G. V. Rusakov, and A. V. Moskalenko.
Water Resources, Vol. 11, No. 4, p 347-354, July-August, 1984. 4 Tab, 6 Ref. Translated from Vodnye Resursy, No. 4, p 95-99, July-August, 1984.

Descriptors: *Water temperature, *Volga Delta, *USSR, *Runoff, Temperature effects, Weather, Deltas, Hydrological regime, Swamps, Lakes.

Water temperature is one of the important elements of the hydrologic regime which has a considerable effect on natural processes in water bodies of the Volga delta (USSR). The temperature regime of various water bodies of the delta is different and depends on the temperature of the water arriving there from the Volgograd reservoir, general weather conditions of the region, daily variation of the air temperature in the delta, depths of the water body, flowage, and its overgrowth by aquatic vegetation. In the shallow channels crisscrossing the delta the flowage is slightly weaker than in the Volga branches, the water temperature is higher than in the Volga but lower than in the backswamp and delta lakes. Heated water can flow into such shallow channels from the back swamps and delta lakes. The temperature regime of the backswamps and delta lakes in the lower part of the Volga-Aktuba floodplain differs somewhat from the temperature regime of the backswamps and lakes of the lower reaches of the delta. This is related to the fact that in the floodplain flooding of the backswamps and lakes occurs rapidly, primarily with cold surface waters of the Volga; the depths are considerably greater; flowage sets in at the start of their flooding; the current speeds are considerable; owing to the absence of dense aquatic and terrestrial vegetation heating of the water column in them occurs gradually and uniformly from the surface to the bottom. The rise of water temperature in water bodies of the delta after the ice period occurs at different times throughout its territory. As a result of regulating the Volga runoff, considerable changes occurred in the characteristics of the temperature regime of the delta water bodies. An increase of the water temperature in the delta water bodies in the fall-winter period already has an effect on the dynamics of the hydrologic and geomorphologic processes occurring in them. The current state of the thermal regime should be taken into account when planning and conducting measures to increase the biological productivity of the delta water bodies. (Baker-IVI)
W86-01809

FINITE AMPLITUDE WAVES IN STRATIFIED TWO-PHASE FLOW: TRANSITION TO SLUG FLOW,
California Univ., Santa Barbara.
R. Ahmed, and S. Banerjee.
AIChE Journal, Vol. 31, No. 9, p 1480-1487, September, 1985. 8 Fig, 13 Ref. NSF grant CP-81-12667.

Descriptors: *Slug flow, *Two-phase flow, *Mathematical equations, Density, Velocity, Waves, Schrodinger equation, Stratified flow, Wave amplitude.

In horizontal two-phase flow, phases stratify due to density differences if the velocity difference between the phases is small relative to the phase velocities. as the velocity difference between the phases is increases, waves appear on the initially smooth interface but the phases remain distinctly separated. At sufficiently high velocity differences interfacial waves grow rapidly, tending to block the flow, i.e., they are swept up to form slugs. A perturbation technique based on the method of multiple scales is used to solve the system of equations governing finite amplitude waves at the interface between two bounded fluids. This method allows the separation of the system into two parts: the rapidly varying phase of the disturbances, and the slowly varying amplitude. The complex system of equations governing the modulation of the wave amplitude can be reduced to a nonlinear Schrodinger equation. Nonlinear instability is essentially determined by the signs of two coefficients in the Schrodinger equations, leading to an analytically established criterion for the growth of finite-amplitude waves at the interface between two bounded flowing fluids. The predictions made by this study are in reasonable agreement with existing experimental results and appear to provide a theoretical framework for interpreting experiments on transition from stratified to slug flow. (Moore-IVI)
W86-01864

2F. Groundwater

EXPERIMENTAL MEASUREMENT OF CHANNELING OF FLOW IN POROUS MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
J. L. Oliphant, and A. R. Tice.
Soil Science, Vol. 139, No. 5, p 394-399, May, 1985. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Soil water, *Channeling, *Porous media, *Permeability coefficient, Unsaturated flow, Montmorillonite, Clays, Hydraulics, Silt.

By comparing experimental measurements of the hydraulic conductivity and the effective self-diffusivity of water in porous media, a channeling parameter, c, is defined. This parameter measures the degree of division of flow paths in the media, but does not depend on the tortuosity of the paths or surface effects on the viscosity of the water. Values of c are obtained for Na-saturated montmorillonites containing from 0.82 to 7.7 g of water per g of clay and for Fairbanks silt containing from 0.135 to 0.23 g of water per g of silt. Values for the montmorillonites remain relatively close to the theoretically predicted value of 1/3 of all water contents, indicating maximally divided flow paths. Values for the silt vary from 100 to over 2000, indicating highly channeled flow. (Author's abstract)
W86-01419

ELECTRICAL RESISTIVITY FOR ESTIMATING GROUND-WATER RECHARGE,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
W. E. Kelly.
Journal of Irrigation and Drainage Engineering, Vol. 11, No. 2, p 177-180, June, 1985. 2 Fig, 7 Ref. NSF grants GK-42130 and ENG 78-19408.

Descriptors: *Groundwater recharge, *Resistivity, *Unsaturated flow, Permeability coefficient, Vadose water, Hydrogeology.

Estimates of recharge rates from surface resistivity measurements should be possible under favorable conditions. Electrical properties of unsaturated soils can be characterized by a form of Archie's law. Differences in resistivity are primarily due to differences in degree of saturation with fine-grained sediments tending to occur in situ at lower resistivities than coarse sediments which occur at lower degress of saturation. On a relative basis, higher transverse resistances would reflect sites more favorable for recharge. Estimates of transverse resistance may be made without interpreting sounding curves in some cases. When sounding curves can be completely interpreted, the resistivity of the vadose zone can be estimated. The resistivity of this layer will be an average transverse resistivity which should correlate with the average hydraulic conductivity of the vadose zone during recharge. Field data under a variety of geohydrological conditions are needed, along with lab work on the electrical properties of unsaturated soils and a study of the geometric effects mentioned. This information would provide a sounder basis for applying the surface resistivity in recharge studies. (Baker-IVI)
W86-01437

THERMAL INFRARED DETECTION OF SUBMARINE SPRINGS ASSOCIATED WITH THE PLYMOUTH LIMESTONE,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
I. S. Roxburgh.
Hydrological Sciences Journal, Vol. 30, No. 2, p 185-196, June, 1985. 11 Fig, 1 Tab, 15 Ref.

Descriptors: *Infrared imagery, *Submarine springs, *Plymouth Limestone, *Devon, *England, Remote sensing, Springs, Groundwater, Limestone, Coastal aquifers, Geomorphology, Geohydrology.

The Plymouth Limestone is the most westerly of a number of separate carbonate outcrops occurring in South Devon, England. In the absence of land-based springs and in the presence of a groundwater gradient which falls seawards from the Upper Devonian slates to the limestone, it is possible that

groundwater discharge from the Plymouth Limestone is taking place through a number of coastal and submarine springs in Plymouth Sound. Freshwater groundwater within the Plymouth Limestone can be shown to be in hydraulic continuity with the marine waters of Plymouth Sound. Fresh groundwater discharges from the limestone in the form of submarine springs can be detected on the basis of temperature differences between the fresh groundwater and the marine waters using an aircraft-mounted thermal infrared linescanner. Analysis of the thermal data is improved and aided by the use of the GEMS color contouring analysis facility. (Collier-IVI)
W86-01443

APPROPRIATE MONITORING TECHNIQUES USING BOMB TRITIUM AND OTHER GEOCHEMICAL PARAMETERS IN HYDROGEOLOGICAL INVESTIGATIONS,
Anambra State Univ. of Technology, Awka (Nigeria). Water Resources and Environmental Pollution Unit.
B. C. E. Egboka.
Hydrological Sciences Journal, Vol. 30, No. 2, p 207-224, June, 1985. 7 Fig, 3 Tab, 40 Ref.

Descriptors: *Tritium, *Isotope studies, *Geochemistry, *Geohydrology, Water chemistry, Monitoring, Radioisotopes, Groundwater movement, Groundwater dating.

Since the atmospheric nuclear tests in 1953, precipitation has contained concentrations of bomb tritium (H-3) higher than the H-3 naturally deposited prior to 1953; consequently, H-3 has been used to investigate groundwater flow systems. It is a tracer for pre-1953 groundwater. A critical review of earlier uses of bomb tritium spotlights problems in its applications that may result in erroneous interpretations. The old monitoring technique using boreholes causes mixing of groundwaters of different age zones. In this study, the mixing problem is overcome by using modern monitoring devices of multi-level samplers and bundle piezometers that yield groundwater samples of small volumes at closely-spaced intervals. The old method may be used to determine recharge and discharge areas of aquifers and used where pollution poses no serious threat. Otherwise, the major pumpage of the aquifer distorts and reverses flow directions, causes mixing of different waters and may spread the pollutants. The disadvantages of the modern method include its restricted use in shallow aquifers and porous media. Case studies for use of tritium as an identifier were conducted at: an abandoned landfill site at the Canadian Forces Base, Borden, Canada; at the Whiteshell Nuclear Research Establishment, Pinawa, Canada; and at the Greenbrook Well Field in Kitchener, Ontario, Canada. The use of isotopes in hydrological studies in Africa is discussed. (Collier-IVI)
W86-01445

DECIPHERING HYDROLOGICAL SYSTEMS BY MEANS OF GEOCHEMICAL PROCESSES,
Geological Survey, Reston, VA.
B. B. Hanshaw, and W. Back.
Hydrological Sciences Journal, Vol. 30, No. 2, p 257-271, June, 1985. 1 Fig, 42 Ref.

Descriptors: *Geochemistry, *Geohydrology, *Groundwater, *Physicochemical characteristics, Carbonate rocks, Aquifers, Saline-freshwater interfaces, Calcite.

The distribution of permeability and chemical character of groundwater in carbonate aquifers is significantly influenced by the many diagenetic processes and reactions that occur in the early development of these rocks. Many of these diagenetic processes occur in the transition zone formed as the carbonate sediments emerge from the marine environment and become fresh-water aquifers. Analyses of trace elements and isotopes indicate that calcite cements and dolomites are formed in this groundwater mixing zone. Reverse reactions such as mineral dissolution and dedolomitization occur in carbonate aquifer systems. The geochemical reactivity of the fresh-water/salt-water mixing zone results from the nonlinearity of geochemical parameters as a function of ionic strength and causes extensive dissolution in coastal carbonate rocks. Interpretation of geochemical reactions and isotopic composition of groundwater provides a method to determine hydrological parameters such as porosity, hydraulic conductivity, and groundwater flow rates. This geochemical method is largely independent of the more conventional approach of determining these parameters by an evaluation of physical properties of aquifer systems. (Author's abstract)
W86-01448

WATER FLOW AND SWELLING PRESSURE IN NON-SATURATED BENTONITE-BASED CLAY BARRIERS,
Luleaa Univ. (Sweden).
L. Borgesson.
Engineering Geology, Vol. 21, No. 3/4, p 229-237, June, 1985. 9 Fig, 5 Ref.

Descriptors: *Bentonite, *Groundwater barriers, *Swelling pressure, Permeability, Water flow, Barriers, Groundwater management, Groundwater pollution, Model studies.

Experiments were devised to determine the water uptake of 10 and 20% bentonite-sand mixtures and of 100% pure bentonite. The swelling pressure situation in an unsaturated clay barrier is very complex especially when the degree of saturation varies through the barrier, and when the access to water is restricted. A piece of bentonite can be highly saturated, and yet it will not exert any pressure on a surrounding stiff material, if it has no further access to water, and if it has been allowed to swell enough to transfer the pressure to something that might be seen as a negative pore pressure. It is necesary to find the influence of the degree of saturation on the swelling pressure in a small clay element, to be able to estimate the pressure in a more complex situation. The swelling pressure reaches a peak value after a relatively short time and then approaches a slightly smaller constant value. The peak value is probably due to either released elastic stresses in the sample, or to the fact that the degree of saturation is very high near the water inlet at the beginning of the test, before the water content is equalized. An equation is derived which serves as a useful model to describe water flow, if there is no temperature gradient. The water diffusion constant in this equation must be determined using the correct initial water content. The model gives better results if the material is partly saturated, than if it is dry. The swelling pressure is a linear function of the degree of saturation. (Baker-IVI)
W86-01455

CARBONATE CHEMISTRY OF RECENT CHALK GROUNDWATER IN A PART OF EAST ANGLIA, U.K.,
Birmingham Univ. (England). Dept. of Geological Sciences.
J. A. Heathcote.
Journal of Hydrology, Vol. 78, No. 3/4, p 215-227, June, 1985. 2 Fig, 3 Tab, 28 Ref.

Descriptors: *Groundwater, *Carbonates, *Chalk Aquifer, *England, Aquifers, Alkalinity, Hydrogen ion concentration, Carbon radioisotopes, Carbon dioxide, Dissolution, Chemical properties.

An example of apparent open-system dissolution is described from a region where a limestone aquifer is recharged through thick calcareous soils developed on till. Groundwaters in the area have higher alkalinities and lower pH-values than are generally reported for carbonate terrains, apparently as a consequence of open-system dissolution. However, limited C-13 isotope data are incompatible with this conclusion, indicating that exchange with the gas phase does not control the isotope chemistry and therefore that the system is isotopically closed. This paradox can be resolved if the dynamics of the system are considered; it is shown that back-diffusion of gas from the solution to the gas reservoir is prevented and therefore isotopic equilibrium between gas and solution is not achieved. Isotope data also show that limited transfer of carbon between soil water and soil calcite occurs. (Author's abstract)
W86-01470

ESTIMATING INTERFACE ADVANCE DUE TO ABRUPT CHANGES IN REPLENISHMENT IN UNCONFINED COASTAL AQUIFERS,
Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.
L. T. Isaacs.
Journal of Hydrology, Vol. 78, No. 3/4, p 279-289, June, 1985. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Coastal aquifers, *Saline-freshwater interfaces, *Replenishment, Dimensional analysis, Saline water wedge, Mathematical equations, Aquifers.

Dimensional analysis is used to establish a functional relationship between the interface toe position and the other parameters for a one-dimensional, unconfined, coastal aquifer subjected to a rapid decrease in replenishment. Non-dimensional curves for the motion of the toe of the salt-water wedge for some cases are presented. The curves were developed from accurate numerical solutions of the equations for motion of the interface and can be used for reliable estimates of the response of interfaces under the conditions assumed for the analyses. An approximate formula for the rate of movement of the toe is derived for the special case when replenishment reduces to zero. (Author's abstract)
W86-01474

INVESTIGATION OF THE RELATION BETWEEN FISSURE FLOW AND DEGREE OF CONTACT AREA BY AN ELECTRIC ANALOGUE MODEL,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
G.-A. Tselentis.
Journal of Hydrology, Vol. 78, No. 3/4, p 325-330, June, 1985. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Geological fractures, *Analog models, *Geohydrology, Groundwater movement, Contact area, Model studies, Flow rate.

Fissures in rock masses are a common feature in the near-surface layers of the Earth's crust, and in many situation they form the primary conduits for water movement. The hydraulic behavior of these fissure systems is very important to many geotechnical activities such as pumping, where it is important to know how the hydraulic properties of the fissure will change under conditions of increasing effective stress and thus increasing contact area. The degree of contact area in a fissure plane is a function of the rock stress across the plane and the elastic properties of the rock surface. A knowledge of the relation between fissure flow rate and the contact area of a fissure is very important, especially when dealing with soft rocks. An electrically conductive paper analogue was used to simulate fluid flow through a partially closed fissure and the flow rate for various degrees of contract area was estimated. The existence of contact areas across a fissure results in a decrease of flow rate and this decrease is a function of the contact area between the rock surfaces. (Moore-IVI)
W86-01477

STUDY OF THE HYDROGEOPHYSICAL PROPERTIES OF FISSURED AQUIFERS USING A DOUBLE POROSITY MODEL,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
G.-A. Tselentis.
Journal of Hydrology, Vol. 78, No. 3/4, p 331-344, June, 1985. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Geological fractures, *Aquifers, *Geophysics, *Porosity, Permeability coefficient, Geophysical formation logs, Hydraulic properties, Electrical properties, Cementation factor.

The purpose of this paper is to examine to what extent the hydrogeophysical properties of fissured aquifers can be derived from geophysical logs alone. To do this a theoretical double porosity model based on a tortuosity-free, parallel conduc-

tion path assumption is introduced and is used to establish possible relations between geophysical parameters that can be measured from conventional geophysical formation logs and the hydraulic characteristics of the aquifer. The relation between the formation's cementation factor and the electrical properties of the water and the solid particles of the formation is investigated and the results are applied for three different types of geologies. Finally an expression for assessing the aquifers hydraulic conductivity from parameters measured from geophysical formation logs is derived. (Author's abstract)
W86-01478

NUMERICAL MODEL OF COMPACTION-DRIVEN GROUNDWATER FLOW AND HEAT TRANSFER AND ITS APPLICATION TO THE PALEOHYDROLOGY OF INTRACRATONIC SEDIMENTARY BASINS,
Illinois Univ. at Urbana-Champaign. Dept. of Geology.
C. M. Bethke.
Journal of Geophysical Research, Vol. 90, No. B8, p 6817-6828, July, 1985. 8 Fig, 1 Tab, 84 Ref, 3 Append.

Descriptors: *Mathematical models, *Groundwater movement, *Heat transfer, *Paleohydrology, *Sedimentary basins, Aquifers, Geothermal gradient, Aquathermal pressuring, Conduction, Hydraulic properties.

A new numerical method allows calculation of compaction-driven groundwater flow and associated heat transfer in evolving sedimentary basins. The model is formulated in Lagrangian coordinates and considers two-dimensional flow in heterogeneous, anisotropic, and accreting domains. Both the continuity of the deforming medium and aquathermal pressuring are explicitly taken into account. A calculation of compaction-driven flow during evolution of an idealized intracratonic sedimentary basin including a basal aquifer predicts slow groundwater movement over long time periods. Fluids in shallow sediments tend to move upward toward the sedimentation surface, and deeper fluids move laterally. The hydraulic potential gradient with depth reverses itself near the basal aquifer, and fluids in this area have a tendency to migrate obliquely into stratigraphically lower sediments. Only small excess pressures develop, suggesting that intracratonic basins are not subject to overpressuring during their evolutions. Owing to the small fluid velocities, heat transfer is conduction-dominated, and the geothermal gradient is not disturbed. Variational studies show that excess hydraulic potentials, but not fluid velocities, depend on assumptions of permeability and that both excess potentials and velocities scale with sedimentation rate. Aquathermal pressuring is found to account for $< 1\%$ of the excess potential developed during compaction. These results cast doubt on roles of compaction-driven flow within intracratonic basins in processes of secondary petroleum migration, osmotic concentration of sedimentary brines, and formation of Mississippi Valley-type ore deposits. Results might also be combined with chemical models to investigate the relationship of compaction flow to cementation in sediments. (Author's abstract)
W86-01485

GROUNDWATER AT HOME AND ABROAD,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 271-283, June, 1985. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Aquifer properties, *Model studies, Groundwater movement, Saline water intrusion, Groundwater recharge, Hydrochemistry, Great Britain, India, Wells, Boreholes, Groundwater management.

Several groundwater situations are considered in Britain and the Indian Subcontinent. Particular attention is given to the differing types of wells and boreholes, the estimation of recharge, and the important features of aquifers. A discussion is also presented of problems that have arisen during exploitation of groundwater including over exploitation, waterlogging and saline intrusion. As no two aquifers are alike, the approach must be varied for each. Although routine field investigations are needed for each study, there are usually certain key features that need to be identified before an adequate understanding can be gained. Identifying the key features is usually the difficult part of the study. In the Lower Mersey Sandstone aquifer it was important to identify the following consideration: before significant abstraction occurred there were many active springs; the actual recharge was less than the potential recharge due to the influence of the drift cover; the ingress of saline water from the Mersey Estuary allowed fresh water to be released for abstraction; hydrochemical information usually reflected conditions in the aquifer several hyundreds of years ago. For the Mehsana area aquifer the following features appear to be significant: only small quantities of water can move laterally through the aquifer; significant verical flow is occurring through the clay layers; and leakage through the beds of canals and water courses is likely to produce a significant increase in the recharge. In a regional groundwater study it becomes important to attempt to fit together the various aspects throughout the study. (Baker-IVI)
W86-01524

HYDROGEOPHYSICAL MODEL FOR RELATIONS BETWEEN ELECTRICAL AND HYDRAULIC PROPERTIES OF AQUIFERS,
Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia).
O. Mazac, W. E. Kelly, and I. Landa.
Journal of Hydrology, Vol. 79, No. 1/2, p 1-19, 1985. 12 Fig, 1 Tab, 38 Ref.

Descriptors: *Aquifer characteristics, *Hydraulic properties, *Electrical properties, Groundwater, Model studies, Hydrologic models, Groundwater flow.

Factors affecting relations between the geoelectric and hydraulic properties of aquifers are considered. The reliability of relations between electrical and hydraulic aquifer parameters depends primarily on two factors: the character of the material-level relationship; and the mutual relation between the direction of groundwater flow, layering and the hydrogeophysical conditions in the aquifer. The sources of errors in determining the basic geoelectric and hydraulic parameters in a set of measurements were analyzed. The necessity of applying a statistical criterion for determining the minimum number of parametric points was stressed. Both direct and inverse material-level relationships can exist depending on the rock type and the character of the hydraulic conductivity. Inverse relationships can be expected when porosity controls variations in hydraulic conductivity and other factors such as grain size, sorting, and clay content are relatively constant. Direct relationships appear to be controlled by inverse correlations between grain size and porosity or inverse correlations between clay content and hydraulic conductivity. A general hydrogeophysical model was used to demonstrate that at the aquifer scale a variety of relations may be expected. (Baker-IVI)
W86-01653

IDENTIFICATION OF PARAMETERS IN UNCONFINED AQUIFERS,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
K. Sridharan, R. Ramaswamy, and N. S. Lakshmana Rao.
Journal of Hydrology, Vol. 79, No. 1/2, p 73-81, July, 1985. 5 Fig, 13 Ref.

Descriptors: *Aquifers, *Pumping tests, *Parameter identification, Optimization, Permeability coefficient, Storage, Specific yield, Sensitivity analysis, Least squares method.

A method is presented for identification of parameters in unconfined aquifers from pumping tests, based on the optimization of the objective function using the least squares approach. Four parameters are to be evaluated, namely: the hydraulic conductivity in the radial and the vertical directions, the storage coefficient and the specific yield. The sensitivity analysis technique is used for solving the optimization problem. Besides eliminating the subjectivity involved in the graphical procedure, the method takes into account the field data at all time intervals without classifying them into small and large time intervals and does not use the approximation that the ratio of the storage coefficient to the specific yield tends to zero. Two illustrative examples are presented and it is found that the parameter estimates from the computational and graphical procedures differ fairly significantly. (Author's abstract)
W86-01657

222RN CONCENTRATIONS AND VARIATIONS IN UNCONFINED GROUNDWATER,
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
For primary bibliographic entry see Field 2K.
W86-01658

EFFECT OF INCOMPLETE RECOVERY PRIOR TO A PUMP TEST IN A LARGE-DIAMETER WELL,
National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta, and V. S. Singh.
Journal of Hydrology, Vol. 79, No. 1/2, p 141-144, July, 1985. 3 Fig, 2 Ref.

Descriptors: *Wells, *Pumping tests, Aquifer characteristics, Water supply development, India, Water level.

In order to have a quick appraisal of the potential of an aquifer for meeting the irrigation needs of small farms and for supplying drinking water in the hard rock terrains of South India, short duration pump tests are carried out. A reliable estimate of hydrogeologic parameters was obtained through a pump test provided the recovery rate prior to the test is fed into a numerical model used for the interpretation of the data. In order to account for the effect of incomplete recovery it is necessary to observe not only the water level variations prior to the onset of pumping but also during the post pumping phase until the recovery is nearly complete for a correct interpretation of pump test data to be made. An appreciable aquifer response is observed only during recovery. The data on the recovery phase of the pump test are, therefore, necessary for the data analysis using the numerical method. Particularly the later portion of the recovery phase is more important, as the effect of pre-pumping incomplete recovery is pronounced in the latter portion only. (Baker-IVI)
W86-01664

MEASUREMENT OF GROUNDWATER RECHARGE ON EASTERN LONG ISLAND, NEW YORK, U.S.A.,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
T. S. Steenhuis, C. D. Jackson, S. K. J. Kung, and W. Brutsaert.
Journal of Hydrology, Vol. 79, No. 1/2, p 145-169, July, 1985. 9 Fig, 6 Tab, 27 Ref.

Descriptors: *Groundwater recharge, *Long Island, *New York, Evaporation, Hydrologic budget, Darcys law, Mathematical equations, Precipitation, Seasonal variation, Vadose zone.

Two methods were tested for their suitability to provide improved estimates of recharge in the region of eastern Long Island (New York). The two methods tested consist, first, of measuring recharge with a direct application of Darcy's law in the vadose zone and, second, of calculating recharge by closure of the hydrologic budget equation with evaporation computed from micrometeorologic data. The recharge figure, now in general use, of 50% of the annual precipitation is a long-term average at best. The measurements of recharge, which were performed during a three-

year period, showed that the vertical flux past the 1 m depth was strongly dependent on both the time of the year and the precipitation amount. In late fall, winter and early spring a high percentage of the precipitation became recharge. During the summer months there was a small net upward movement of water past the 1 m depth. Precipitation during these months did not contribute to the annual recharge. It may be concluded from these measurements that in order to estimate recharge, special attention should be given to precipitation during the winter months. A better estimate for annual recharge than the current 50% of annual precipitation might be to take approximately 75-90% of the precipitation from October 15 until May 15. The two methods used for estimating recharge were labor intensive and required experienced technicians. Currently, one method cannot be recommended above the other. Both methods give a good estimate during the year except for the winter. The closure method using micrometeorological data gives a slightly higher estimate than the direct measurement method based on Darcy's law. (Author's abstract)
W86-01665

GROUNDWATER PROTECTION IN SAN FRANCISCO BAY AREA,
California Regional Water Quality Control Board, Oakland.
For primary bibliographic entry see Field 5G.
W86-01724

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-01731

SIMULATION OF TWO-FLUID RESPONSE IN VICINITY OF RECOVERY WELLS,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
G. P. Lennon.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1156-1168, August, 1985. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Recovery wells, *Dense fluids, *Aquifers, *Groundwater pollution, Boundary conditions, Geohydrology, Wells, Saline-freshwater interfaces, Density.

A dense fluid in an unconfined aquifer is usually removed by pumping a recovery well screened in the region of the aquifer occupied by the fluid. For many problems, the transition zone separating the dense fluid from the overlying water can be modeled as a sharp interface. When the pumping begins, the interface is drawn downward, allowing water to enter the well. The recovery process is improved if a second well is drilled and screened in the zone occupied by the water. The simultaneous pumping of water tends to cause the interface to move upward, allowing the dense fluid to be recovered at an increased rate without water entering the recovery well. The boundary integral equation method (BIEM) is used to solve the problem of the response of a dense fluid near a recovery well in a ground-water aquifer. The axisymmetric problems considered here are time-dependent and involve a nonlinear boundary condition along the free surface, as well as a nonlinear, moving interfacial boundary. The entire boundary, including the moving boundaries, are discretized into axisymmetric finite elements for evaluating the required boundary integrations. Numerical examples include pumping both fluids simultaneously as well as separately. The model is used to illustrate the design of a recovery system for the efficient removal of the dense fluid. (Author's abstract)
W86-01733

ANALYSIS OF SOME LABORATORY TRACER RUNS IN NATURAL FISSURES,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
L. Moreno, I. Neretnieks, and T. Eriksen.
Water Resources Research, Vol. 21, No. 7, p 951-958, July, 1985. 11 Fig, 5 Tab, 12 Ref.

Descriptors: *Geological fractures, *Tracers, *Model studies, Advections, Dispersion, Diffusion, Sorption, Hydrodynamics, Residence time, Solute transport, Dispersivity.

Tracer tests in natural fissures performed in the laboratory are analyzed by means of fitting two different models. In the experiments, sorbing and nonsorbing tracers were injected into a natural fissure running parallel to the axis of a drill core. The models take into account advection, dispersion, diffusion into the rock matrix, and sorption onto the surface of the fissure and on the microfissures inside the matrix. For the second mechanism, one of the models considers hydrodynamic dispersion, while the other model assumes channeling dispersion. The models take into account time delays in the inlet and outlet channels. The dispersion characteristics and water residence time were determined from the experiments with nonsorbing tracers. Surface and volume sorption coefficients and data on diffusion into the rock matrix were determined for the sorbing tracers. The results are compared with values independently determined in the laboratory. Good agreement was obtained using either model. When these models are used for prediction of tracer transport over larger distances, the results will depend on the model. The model with channeling dispersion will show a greater dispersion than the model with hydrodynamic dispersion, assuming constant dispersivity. (Author's abstract)
W86-01767

COMPONENTS OF FLOW RESULTING FROM ABSTRACTION IN A TWO-LAYERED CONFINED AQUIFER WITH NO CROSS FLOW,
Institute of Hydrology, Wallingford (England).
R. S. Wikramaratna.
Water Resources Research, Vol. 21, No. 7, p 985-989, July, 1985. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Wells, *Well storage, *Confined aquifers, Artesian wells, Pumping, Well screens, Well casings, Mathematical equations, Groundwater movement, Transmissivity.

The problem of abstraction from a well penetrating a two-layered confined aquifer, each layer being independently homogeneous, isotropic, and artesian, is considered. Three components of the total abstraction are identified: the concentration from well storage and contributions from flow in each of the aquifer layers. Analytical expressions were derived for the three components; the expressions were evaluated numerically for different parameter sets in order to investigate the transient variation in the relative importance of the components. In the initial stages of pumping, well bore storage is the dominant factor, but the contribution falls effectively to zero as abstraction progresses. The length of time during which well bore storage provides a significant proportion of the total flow is dependent on the aquifer parameters as well as on the screen and casing radius. Reduction of the screen radius results in increased drawdown and a small increase in the importance of well bore storage during the early stages of pumping. In all cases, after a sufficiently long time of pumping, the aquifer flow contribution are divided in the same proportion as the transmissivities of the two layers. (Moore-IVI)
W86-01770

MULTIVARIATE ANALYSIS AND INTERPRETATION OF THE HYDROCHEMISTRY OF A DOLOMITIC REEF AQUIFER, NORTHERN ITALY,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
E. Seyhan, A. A. van de Griend, and G. B. Engelen.
Water Resources Research, Vol. 21, No. 7, p 1010-1024, July, 1985. 12 Fig, 4 Tab, 32 Ref.

Descriptors: *Multivariate analysis, *Hydrochemistry, *Dolomite aquifers, *Italy, Hydrogeology, Isotopes, Groundwater, Chemical properties, Aquifers, Environmental tracers.

Regionalization based on multivariate statistical analyses of hydrochemical data and environmental isotopes proved most successful in differentiating groundwater of different hydrogeological origins within the Sasso Lungo dolomitic mountain stock, Northern Italy. The approach used chemical and isotopic data to evaluate hydrologic properties normally determined by more traditional techniques. From field and laboratory studies of 19 hydrochemical variables measured at 46 sampling points, three distinct groups of water types were differentiated, in close agreement with hydrogeological evidence, namely, (1) pure Sciliar dolomite water, (2) water from volcanic deposits, and (3) mixed water from Sciliar dolomite and volcanic deposits. Environmental isotopes are used to support hydrogeological observations and the hydrochemical analyses and also to provide valuable additional information for futher distinction between hydrogeological subsystems. The data show that the dolomite aquifer discharges from two main subsystems: (1) relatively young, shallow to moderately deep waters in the central part of the reef stock and (2) older groundwater discharging at the rims of the reef. (Author's abstract)
W86-01773

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA; 1. THE NONREACTIVE CASE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. A. Sudicky, R. W. Gillham, and E. O. Frind.
Water Resources Research, Vol. 21, No. 7, p 1035-1041, July, 1985. 3 Fig, 22 Ref.

Descriptors: *Porous media, *Solute transport, *Stratified media, Tracers, Simulation, Diffusion, Dispersion, Aquifers, Sand, Silt, Model studies.

The migration of a nonreactive solute in layered porous media was studied under controlled laboratory conditions by injecting a tracer into a thin sand layer bounded by silt layers. The experimental results show a delay in the breakthrough of the tracer in the effluent of the permeable sand layer along with a substantial decrease in concentrations after a 1-m travel distance. The strongly dispersed and skewed shape of the breakthrough curves for the layered system is in contrast to the symmetric and weakly dispersed concentration patterns typically associated with homogeneous media. Because of the tailing of the breakthrough measurements, a departure from classical Fickian transport is apparent. Simulations of the experiments demonstrate that these effects are the result of a transient redistribution of the tracer across the strata by transverse molecular diffusion and that local longitudinal dispersion is only of secondary importance as a spreading process in such systems. These findings are consistent with recent theoretical descriptions of dispersion in stratified aquifers. (Author's abstract)
W86-01775

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA 2. THE REACTIVE CASE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. C. Starr, R. W. Gillham, and E. A. Sudicky.
Water Resources Research, Vol. 21, No. 7, p 1043-1050, July, 1985. 7 Fig, 13 Ref.

Descriptors: *Solute transport, *Porous media, *Stratified media, Simulation, Mathematical models, Strontium radioisotopes, Tracers, Sand, Silt, Advection, Diffusion, Retardation.

Laboratory experiments and mathematical simulations were used to investigate the transport of a reactive solute, Sr-85, through a sand layer located between two silt layers. The experimental results showed breakthrough curves that were similar in form to those reported in the preceeding paper for a nonreactive solute, but were delayed in the time of appearance, had a lower peak concentration, and were more highly dispersed. A mathematical model that accounts for longitudinal advection in the sand layer, transverse diffusion in the silt layers, and retardation in both the sand and silt

layers was used to simulate the experimental results. With a trial-and-error adjustment of the retardation coefficients, the mathematical model gave a good representation of the experimental data; however, different parameter values were required in order to simulate breakthrough curves measured at different values of the pore-water velocity in the sand. The use of measured retardation parameters in the model produced a much better fit to the data compared to that which was obtained when retardation was neglected. Nevertheless, significant discrepancies existed between the measured and simulated results, with the discrepancies becoming greater at lower velocities. In view of the excellent agreement between measured and simulated results obtained in part 1 for nonreactive solutes, the less satisfactory agreement obtained here suggests that there is some physical or chemical aspect of the retardation process that is not adequately represented in the model. (Author's abstract)
W86-01776

FORMATION OF USEFUL GROUNDWATER RESOURCES IN THE SOUTHWESTERN PART OF THE MOSCOW ARTESIAN BASIN UNDER INTENSE WITHDRAWAL CONDITIONS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
B. V. Borevskii, V. A. Polyakov, and L. A. Subbotina.
Water Resources, Vol. 11, No. 4, p 293-303, July-August, 1984. 4 Fig, 2 Tab, 11 Ref. Translated from Vodnye Resursy, No. 4, p 35-47, July-August, 1984.

Descriptors: *Mesozoic-Cenozoic Aquifer, *Leakage, *Groundwater movement, *Moscow, *USSR, Artesian basin, Selective withdrawal, Hydrogeology, Groundwater depletion.

The presence of leakage from the Mesozoic-Cenozoic aquifer complex into the Upper Devonian complex through the Neocomian-Jurassic clay stratum was established from the data of hydrodynamic, hydrochemical, hydrogeothermal, and isotropic investigations. A quantitative estimate made on the ES-1022 digital computer of all main sources of formation of useful resources with the existing withdrawal was given and it was proved that more than half of withdrawal is provided by leakage from the Mesozoic-Cenozoic aquifer complex. Useful groundwater resources were estimated up to the year 2000, and a quantitative estimate of the sources of their formation was given for this period with different variants of withdrawal. The possibility of not only keeping the existing withdrawal up to 2000 but also of its substantial increase (by almost 2-fold) by locating new intakes in the west, near the Sechcha channel, along the Desna valley, was proved. Such investigations can be recommended when conducting works under analogous hydrogeological conditions to study the conditions of formation and to estimate useful groundwater resources. (Baker-IV)
W86-01803

EVALUATION OF THE EFFECTIVENESS OF ITERATIVE METHODS FOR MODELING GROUNDWATER FLOW ON DIGITAL COMPUTERS,
Moscow State Univ. (USSR).
L. K. Gokhberg, N. A. Mossakovskaya, and A. A. Roshal.
Water Resources, Vol. 11, No. 4, p 316-324, July-August, 1984. 5 Fig, 10 Ref. Translated from Vodnye Resursy, No. 4, p 61-69, July-August, 1984.

Descriptors: *Computers, *Model studies, *Groundwater movement, Mathematical models, Costs, Algorithms, Hydrogeology.

Numerical modeling methods on digital computers in recent years have been introduced in hydrogeological investigations. A wide range of methods is recommended for use and is being used. At the same time, the effectiveness of using various methods is insufficiently elucidated in the literature. Among the most important characteristics of the numerical method from the standpoint of effectiveness of its technical application on digital computers are use of computer time and the size of the working field of the main storage. The computer experiments conducted on the test problems showed that with respect to computation time, the Seidel method is slightly inferior to the block iteration method, winning, however, in simplicity of the algorithm. (Baker-IVI)
W86-01805

INVESTIGATION OF THE HYDRODYNAMIC PROBLEMS OF SEEPAGE AND CONVECTIVE DIFFUSION IN INHOMOGENEOUS AND ANISOTROPIC POROUS MEDIA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. G. Khublaryan, O. M. Churmaev, and I. O. Yushmanov.
Water Resources, Vol. 11, No. 3, p 185-191, May-June, 1984. 5 Fig, 16 Ref. Translated from Vodnye Resursy, No. 3, p 23-29, 1984.

Descriptors: *Groundwater level, *Seepage, *Diffusion, *Hydrodynamics, Porous media, Convection, Anisotropy, Mathematical equations.

The problem of predicting the groundwater level is becoming ever more urgent in connection with the increasing anthropogenic impact on rivers and subsurface waters. Transfer of part of the runoff from one river basin to another and the creation of reservoirs and other hydraulic structrues is leading to a change in the paramters of flow which in turn causes a change in the groundwater level of adjacent territories. Few investigations have been performed in which fluid flow in inhomogeneous media is studied. This work is a further development of the hydrodynamic problem of seepage and convective diffusion for the case of inhomogeneous and anisotropic media. Examples are given which demonstrate how important the characteristics of a porous medium are. Schematization and assumption of physicochemical paramters as constant are not always valid. (Baker-IV)
W86-01818

FLOW OF A WELL IN AN INHOMOGENEOUS LAYERED ARTESIAN AQUIFER,
N. N. Lapshin.
Water Resources, Vol. 11, No. 3, p 192-203, May-June, 1984. 2 Fig, 12 Ref. Translated from Vodnye Resursy, No. 3, p 30-43, May-June, 1984.

Descriptors: *Aquifer characteristics, *Wells, Water flow, Groundwater movement, Artesian wells, Permeability, Flow rate, Water table, Hydrogeology.

Inhomogeneous layered media with complete consideration of two-dimensionality in the section of the groundwater flow in each of the layers composing the aquifer were studied theoretically. An artesian aquifer is examined which consists of two zones of different permeability. The length of the filter of the pumping well amounts to only part of the thickness of one of the layers of the two-layer aquifer. The main hydrogeologic parameters of a two-layer aquifer to be determined when conducting experimental seepage flow studies are the total value of transmissivity T and pressure conductivity factor, as well as the permeability coefficients of the layers composing the aquifer. It is necessary to determine these indices considering the main properties of groundwater flow during pumping in inhomogeneous aquifers. Flow imperfection of wells due to partial penetration in an inhomogeneous two-layer aquifer is determined to a considerable extent by the pressure conductivity factor. (Baker-IVI)
W86-01819

ESTIMATION OF SAFE GROUNDWATER YIELD WITH CONSIDERATION OF CYCLIC VARIATION OF THE WATER WITHDRAWAL RATE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
S. Ya. Kontsebovskii, and E. I. Minkin.
Water Resources, Vol. 11, No. 3, p 204-217, May-June, 1984. 2 Fig, 4 Tab, 4 Ref. Translated from Vodyne Resursy, No. 3, p 44-59, May-June, 1984.

Descriptors: *Drawdown, *Groundwater, Water level, Mathematical equations, Safe yield, Water management, Irrigation water.

The existing methods of calculating the drawdown of the level (head) of groundwaters with periodic withdrawal are based on representing the withdrawal graph in the form of several steps. Random variations in the times of flushing, water spreading, and crop irrigations result in the form of the average long-term graph of the variation of ground water withdrawal for irrigation being rather smooth. The value of the lag depends on the relationship of the values of the maxima of withdrawal and duration of the time interval between them. The lags between the peak values of withdrawal and drawdown, which under certain conditions reach several months, can have a substantial effect on estimating the safe yield for irrigation. The value of the permissible drawdown assigned on the basis of thickness of the aquifer is not an exactly determined constant, but varies within certain limits. Consideration of the displacement of the peak values of drawdown with respect to the peak of withdrawal when estimating the safe yield can be expressed in an increase of the calculated values of the permissible drawdown to its upper limit. In certain cases, this value can probably be greater, taking into account that a brief drop of the level below the permissible value will occur in a period when the rate of withdrawal is substantially less than the peak value and probable disconnection of part of the wells will not lead to so substantial a complication of the water management situation as would occur at the height of crop irrigation. (Baker-IVI)
W86-01820

USES AND ABUSES OF WASTEWATER INJECTION WELLS IN HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
F. L. Peterson, and J. A. Oberdorfer.
Pacific Science, Vol. 39, No. 2, p 230-240, 1985. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Injection wells, *Wastewater disposal, *Hawaii, Domestic wastewater, Well clogging, Geohydrology, Nitrogen gas, Injection well capacity, Particulate matter, Microorganisms.

During the past two decades in Hawaii, more than 500 injection wells for the disposal of domestic sewage wastewater have been constructed and operated. Thus far, contamination of potable groundwater supplies has not been a problem. Many of the injection wells, however, have not performed as designed, and aquifer clogging and reduced injection capacity have produced numerous well failures resulting in public health, legal, and financial problems. Factors most commonly responsible for the well problems have been unfavorable hydrogeology, underdesign of injection well capacity, poor effluent quality, and lack of injection well maintenance. Detailed study of clogging mechanisms in the immediate vicinity of injection wells suggests that binding of pore spaces by nitrogen gas is the most important cause of aquifer clogging. Other clogging mechanisms also operating are filtration of solid particles and growth of microorganisms. (Author's abstract)
W86-01884

GROUND-WATER RESOURCES OF TOWNER COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
P. G. Randich, and R. L. Kuzniar.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. North Dakota State Water Commission County Ground-Water Studies 36 and North Dakota Geological Survey Bulletin 79, Part III. 26 p, 5 fig, 3 tab, 51 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, Transmissivity, Recharge, Water use,

Chemical properties, Potential yield, Storage, Towner County, North Dakota.

Large quantities of water can be obtained from glacial-drift aquifers in Towner County, North Carolina. Glacial-drift aquifers occur as saturated sand and gravel deposits that range in thickness from 4 to 287 feet. These aquifers underlie about 550 square miles and contain approximately 2.8 million acre-feet of available ground water. Potential well yields range from 5 to 1,500 gallons per minute. The most extensive and productive is the Spiritwood aquifer system. Chemical quality of the water varies greatly, but the dominant cations are sodium and calcium and the dominant anions are sulfate and bicarbonate. The Pierre aquifer consists of a fractured siliceous shale that ranges from 25 to 400 feet in thickness in the upper part of the Pierre Shale. The Pierre aquifer underlies all of Towner County. Wells developed in the aquifer generally yield less than 10 gallons per minute. The chemical quality of the water in the Pierre also is highly variable. The dominant cation is sodium and the dominant anion generally is chloride. The rural population and most communities in Towner County depend on ground water as a source of supply. (USGS)
W86-01917

LEACHING STUDY OF OIL SHALE IN KENTUCKY WITH A SECTION ON HYDROLOGIC RECONNAISSANCE OF THE OIL SHALE OUTCROP IN KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01918

2G. Water In Soils

NON-DARCIAN WATER FLOW IN PEAT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond, and J. C. Goldman.
Journal of Ecology, Vol. 73, No. 2, p 579-584, July, 1985. 1 Fig, 14 Ref.

Descriptors: *Peat, *Permeability coefficient, *Seepage, Soil water, Flow discharge, Pore pressure, Darcys law, Interstitial water.

Dramatic changes in the apparent hydraulic conductivity of peat observed by several investigators during seepage-tube and auger hole tests in both recharge and depletion modes can be explained by the large elastic storativity of peat, which renders steady-state analytical methods inappropriate. Such observations alone are not inconsistent with Darcian peat behavior. A lesser degree of non-Darcian peat behavior suggested by constant head steady state experiments may be explainable in part by vertical effective stress and compressibility effects. Results of in situ conductivity tests in mires can also be affected by other factors, such as local alterations of vertical effective stress by the weight of observers. The three-dimensional, heterogeneous nature of the situation in the field further complicates analysis; for example, where large horizontal gradients are imposed on the peat by a seepage-tube test, local changes in peat-pore geometry due to changes of horizontal stresses may also occur. The accurate measurement and interpretation of peat hydraulic conductivity remains an extremely difficult problem. Darcy'a Law is seen to be appropriate for use in upper unhumified or slightly humified peats. Even in humified peats under natural conditions of constant pore-water chemistry, small hydraulic gradients, and fairly constant effective stress, the existing data may not be inconsistent with the satisfactory application of Darcy's Law. Field measurement methods which provide steady state condition and minimal alteration of effective stresses are likely to provide the most accurate information for hydrologic models. It is suggested that the minimum practicable alteration of pore pressure be a criterion for the design of methods to measure peat hydraulic conductivity under field conditions. (Baker-IVI)
W86-01359

EXPERIMENTAL MEASUREMENT OF CHANNELING OF FLOW IN POROUS MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2F.
W86-01419

CHARACTERIZATION OF PORE SIZE DISTRIBUTIONS WITHIN SOILS BY MERCURY INTRUSION AND WATER-RELEASE METHODS,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
K. R. Olson.
Soil Science, Vol. 139, No. 5, p 400-404, May, 1985. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Soil water, *Pore size, *Pores, *Pore water, *Mercury intrusion method, *Water release method, Roots, Sand, Clay, Soil properties.

Soil pore size distributions for undisturbed, oven-dried peds were measured and interpreted using mercury intrusion porosimetry. The pore size distributions were compared with those calculated from moisture release data. A correlation between water retention difference by water-release methods and water storage pore volumes (50 to 0.5 microns) by mercury intrusion was established with an R squared = 0.58 over a variety of soil texture and bulk density ranges. Most of the variation occurred for soil samples high in either sand or clay. In addition, root-restricting class limits were developed based on volume of root size pores (200 to 10 microns) within oven-dried peds that were large enough to permit root tip and root hair penetration. (Author's abstract)
W86-01420

SLEEVE AND CASING LYSIMETERS FOR SOIL PORE WATER SAMPLING,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W86-01422

DESIGN OF A SENSITIVE AND PRACTICAL CLOSED-TOP INFILTROMETER,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
R. S. Malik, S. K. Sharma, and J. S. Dhankar.
Soil Science, Vol. 139, No. 5, p 452-457, May, 1985. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Infiltrometers, *Infiltration, *Soil water, Soil types, Moisture meters, Measuring instruments, Water depth.

A two-piece, closed-top infiltrometer with a 10-cm diameter was designed which measures infiltration under constant and naturally occurring low surface water head. Field tests were conducted in cultivated sandy and fine loamy soils with varying ring size, depth, and surface water head conditions. Mean cumulative infiltrations obtained with this infiltrometer are not significantly different from those with an open-top, falling-head infiltrometer at all times. Measurements with the designed infiltrometer are more reproducible, and hence fewer infiltration runs are needed to characterize the average infiltration parameters of a given area. The mean and coefficient of variation in cumulative infiltration of 60 min are 13.88 and 8.29% in sandy soil, respectively. The corresponding values for an open-top, falling-head infiltrometer are 13.56 and 17.55%, respectively. The designed infiltrometer does not present parallax and floating material problems. The time lag in taking zero time reading is reduced from 6.3 to 2.4 s. The sensitivity of the designed infiltrometer is 0.025 cm; that of a conventional infiltrometer is 0.1 cm. It is more practical, in general, and for remote areas of short water supply, in particular. Mean cumulative infiltration did not differ significantly with increasing ring size from 10- to 30-cm diameter. The coefficient of variation decreased at all times with the increase in size. The optimum outer ring depth was 10 cm, which was equal to the inner ring depth. The cumulative infiltration increased with increase in surface water head at all times, especially when it is increased in the higher range from 5 to 10 cm. (Author's abstract)
W86-01423

NOTE: THE RELATION BETWEEN DESORPTIVITY AND SOIL-WATER DIFFUSIVITY,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, M. Vauclin, R. Haverkamp, and I. Lisle.
Soil Science, Vol. 139, No. 5, p 458-461, May, 1985. 1 Fig, 14 Ref.

Descriptors: *Desorptivity, *Soil water, *Diffusivity, *Desorption, Sorptivity, Drainage, Infiltration.

In the absence of gravity, the amount of water removed by desorption from a soil with uniform initial water content and constant suction at the surface is proportional to 1/2. The coefficient of proportionality is called desorptivity, by analogy with sorptivity, for the infiltration of water. A formula was derived relating desorptivity to soil-water diffusivity. The accuracy of the formula is illustrated with numerical, theoretical, and experimental examples. Desorptivity is shown to be much smaller than sorptivity, and this difference explains why gravity effects are normally important much earlier for drainage than for infiltration. (Author's abstract)
W86-01424

NOTE ON THE USE OF A SIMPLE NUMERICAL MODEL FOR VERTICAL, UNSATURATED FLUID FLOW,
Warren Spring Lab., Stevenage (England).
J. M. Kirby.
Soil Science, Vol. 139, No. 5, p 462-467, May, 1985. 11 Fig, 6 Ref.

Descriptors: *Numerical models, *Vertical flow, *Unsaturated flow, *Soil water, *Model studies, Permeability coefficient, Soil water suction, Drainage, Clays, Soil types, Soil properties, Data interpretation.

The simulation of vertical fluid flow in unsaturated cells usually starts with a form of the vertical water transport equation. The strong nonlinearity of the equation creates difficulties in its solution. Numerical techniques require small time and length steps to obtain a stable and accurate solution. A previously published simple numerical model overcame these difficulties but was applied only to soils that are not too dry; the model was later extended to cover dry soils. The previously published model uses an exponential approximation for the unsaturated conductivity to derive a simple expression for vertical, unsaturated fluid flow and the later work makes use of several exponential segments to approximate the unsaturated conductivity, which extends the method to a wider range of soils and moisture contents. However, this leads to a difficulty in the solution and can create a discontinuity in the predicted moisture content-depth profile. A method is demonstrated for removing this difficulty and the resulting discontinuity and the method is applied to two examples of drainage problems and to infiltration into Yolo light clay. The method yields accurate results for both types of problems and the accuracy is retained even with large time and depth steps. It should be realized that the accuracy depends upon the approximation of the unsaturated conductivity and suction data; a poor choice can give very misleading results. The choice of approximations is straightforward when the data for suction and log (permeability) fall in straight lines. When the data are in the form of a continuous curve, however, several approximations will be needed and must be chosen such that the data are approximated well in the suction region of most interest in the solution. (Collier-IVI)
W86-01425

CALDEP: A REGIONAL MODEL FOR SOIL CACO3 (CALICHE) DEPOSITION IN SOUTHWESTERN DESERTS,
San Diego State Univ., CA. Systems Ecology Research Group.

G. M. Marion, W. H. Schlesinger, and P. J. Fonteyn.
Soil Science, Vol. 139, No. 5, p 468-481, May, 1985. 11 Fig, 2 Tab, 44 Ref. NSF grant BRS 8212466.

Descriptors: *Geochemistry, *Calcium carbonate deposition, *Desert soils, *Soils, *Model studies, *Caliche, Soil types, Evapotranspiration, Hydrologic cycle, Soil water.

A regional model for CaCO3 deposition in desert soils of the southwestern United States was developed and validated. There were five major components in the simulation model: a stochastic precipitation model, an evapotranspiration model, chemical thermodynamic relationships, soil parameterization, and a soil water and CaCO3 flux model. For the present climate, a cold-dry Pleistocene climate, and a cool-wet (summer) Pleistocene climate, the model predicted a shallower depth for the calcic horizon than was found in field soils. However, the model was compatible with field soils if one assumed that most pedogenic carbonate formed during a cool-wet (winter) Pleistocene climate. The model was highly sensitive to the frequency of extreme precipitation events and to soil water-holding capacity. The biotic factor played an important role in CaCO3 deposition through its control of soil CO2 concentrations and evapotranspiration rates. The range in predicted CaCO3 deposition rates agreed with the rates for most field studies (1 to 5 g/sq m/yr); also, the model predicted an increasing rate of CaCO3 deposition with increasing precipitation, which agreed with field studies. The model is a valuable research tool for evaluating the role of state factors on soil CaCO3 deposition. (Author's abstract)
W86-01426

DRAINAGE COEFFICIENTS FOR HEAVY LAND,

Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
L. K. Smedema.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 101-112, June, 1985. 6 Fig, 3 Tab, 7 Ref, 1 Append.

Descriptors: *Drainage, *Heavy land, *Soil properties, *Surface drainage, *Netherlands, *Yugoslavia, *Tanzania, *Soil density, Rainfall, Percolation, Clays, Basin clays, Soil types, Permeability coefficient.

Drainage of heavy land is largely governed by the fact that the hydraulic conductivity (K-value) of the subsoil is generally too low (often K<0.01 m/day) to permit ready percolation of excess rain water to lower depths. Under these conditions, drainage discharge predominantly takes the form of 'shallow drainage' - lateral interflow through the more permeable toplayer and overland flow. Evidence is presented that this type of 'shallow drainage' discharge can be described by the linear reservoir type rainfall-discharge model. According to this model, the discharge at any time, t, is linearly dependent on the current dynamic storage and the excess rain which has not yet been discharged at time t. Results were evaluated by comparison with other methods of deriving drainage coefficients and with commonly used design standards. Case studies were made of a Netherlands drainage basin clay land with mixed farming, of a Yugoslavian drainage of basin clay with mostly arable farming (maize and wheat), and of a Tanzanian drainage of sugarcane fields on heavy basin clay land. The proposed method yields values of the correct order of magnitude and is based on a physical model of the drainage processes involved, making it universally applicable. (Collier-IVI)
W86-01431

LOW GRADIENT PERMEABILITY MEASUREMENTS IN A TRIAXIAL SYSTEM,

Geological Survey, Denver, CO.
H. W. Olsen, R. W. Nichols, and T. L. Rice.
Geotechnique, Vol. 35, No. 2, p 145-157, June 1985. 15 Fig, 2 Tab, 20 Ref.

Descriptors: *Permeability, *Triaxial systems, *Flow-pump method, Soil properties, Soil types, Sand, Clay, Silt, Soil water, Unsaturated zone.

Permeability measurements were conducted with the flow-pump method on sand, sandy silt and silty clay specimens in a conventional triaxial system by introducing and withdrawing water at known constant flow rates into the base of a specimen with a flow-pump, and by monitoring the head difference induced across the length of the specimen with a sensititive differential pressure transducer. The results show that the previously reported advantages of the flow-pump method, compared with conventional constant head and falling head methods, were realized for permeability measurements in conventional triaxial equipment. These advantages are that direct flow rate measurements are avoided together with the associated errors that arise from the effects of contaminants on capillary menisci and the long periods of time involved in flow rate measurements; permeability measurements can be obtained much more rapidly and at substantially smaller gradients; errors from the small intercept in the otherwise linear flow rate versus hydraulic gradient relationship, and also from seepage-induced permeability changes, can easily be recognized and avoided or minimized. The results further show that the initial transient response of a specimen that precedes the steady state condition needed for a permeability measurement can require a substantial period of time. In this study the response times varied from a fraction of a minute for a sand specimen to more than 200 minutes for a silty clay specimen. Errors in permeability measurements from this transient response can easily be avoided with the flow-pump method but not with constant head and falling head methods. (Author's abstract)
W86-01450

DIFFERENTIAL EVAPO-TRANSPIRATION FROM A CLAY SURFACE AND ITS INFLUENCE ON EQUILIBRIUM POREWATER PRESSURE,

Golder Associates, Maidenhead (England).
R. E. Gibson, M. H. Goldsworthy, and A. M. Chandler.
Geotechnique, Vol. 35, No. 2, p 181-191, June, 1985. 5 Fig, 6 Tab, 7 Ref.

Descriptors: *Evapotranspiration, *Porewater pressure, *Clay, *Groundwater movement, Settlement, Soil water, Evaporation, Transpiration.

The derivation is presented of expressions resulting from a steady state groundwater flow approach to determining the porewater pressure changes caused by modification of the rate of evapo-transpiration over limited areas of the ground surface. Solutions to the expressions have been computed for positions throughout the soil layer for a variety of shapes and sizes of affected area. The tabulated results may be used to estimate the effects for a wide range of conditions by making use of the principle of superposition. Case histories are presented in which observations of porewater pressure changes and of ground movement are compared with the values derived from the tabulated results. (Author's abstract)
W86-01451

WATER FLOW AND SWELLING PRESSURE IN NON-SATURATED BENTONITE-BASED CLAY BARRIERS,

Luleaa Univ. (Sweden).
For primary bibliographic entry see Field 2F.
W86-01455

OBSERVATIONS OF THE BEHAVIOUR OF LARGE CORES OF SOIL DURING DRAINAGE, AND THE CALCULATION OF HYDRAULIC CONDUCTIVITY,

Oxford Univ. (England). Dept. of Agricultural and Forest Science.
W. R. Kneale.
Journal of Soil Science, Vol. 36, No. 2, p 163-171, June, 1985. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Permeability coefficient, *Drainage, *Soil water, Matric potential, Macropore channels, Interstitial water, Air entry.

This paper reports observations on the behavior of large cores of undisturbed clay-loam soil during the drainage of water under an imposed step in potential. Rates of outflow and the matric potential at various points in the core were recorded during drainage. The volumes of 'macropore-channels' (large, continuous voids) were estimated to be 0.005 cu m/cu m in a subsoil sample, and 0.026 cu m/cu m in a topsoil sample from arable land. The calculated values of hydraulic conductivity were found to vary with the size of the step in potential imposed on the sample at the start of each drainage experiment. The available evidence suggested that the apparant K/Psi m relationship was influenced by the rate that air could enter the soil to replace water during drainage. The degree of restriction on air movement was affected by the initial drainage behavior, and this varied with the imposed step in potential. (Author's abstract)
W86-01467

NITROGEN MINERALIZATION IN A SEQUENCE OF HYDROMORPHIC SOILS IN A VALLEY IN THE HIGH SEMOIS (BELGIUM) (MINERALISATION DE L'AZOTE DANS UNE SEQUENCE DE SOLS HYDROMORPHES DE LA VALLEE DE LA HAUTE SEMOIS (BELGIQUE)),

Universite Libre de Bruxelles (Belgium). Lab. de Botanique Systematique et d'Ecologie.
F. Baillon, J. Herbauts, and M. Tanghe.
Acta Ecologica, Vol. 6, No. 2, p 183-192, 1985. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Nitrogen, *Mineralization, *Hydromorphic soils, *Semois, *Belgium, Humic soils, Water table, Nitrification, Vegetation, Soil water.

In the alluvial plain of the Semois (Belgium), both in situ and in vitro, nitrogen availability of humic layers was studied in relation with the yearly fluctuations of the water-table in a sequence of more or less hydromorphic soils. The fluctuations of the water-table were measured using a sequence of 15 piezometers disposed throughout a transect overlying successively a peaty grassland with Molinia caerulea, a tall-herb community with Filipendula ulmaria and a reed-bed with Phalaris arundinacea. Results show that, during the vegetation period, nitrogen mineralization is almost not affected by the degree of hydromorphy of the humic layers: nitrogen mineralization rates are not significantly different in the 3 studied sites and in every case nitrification is the dominant process. (Author's abstract)
W86-01510

COMPARATIVE WATER RELATIONS OF ADJACENT CALIFORNIA SHRUB AND GRASSLAND COMMUNITIES,

Pepperdine Univ., Malibu, CA. Natural Science Div.
For primary bibliographic entry see Field 2I.
W86-01602

ANALYSIS OF SOLUTE BREAKTHROUGH CURVES TO PREDICT WATER REDISTRIBUTION DURING UNSTEADY FLOW THROUGH UNDISTURBED STRUCTURED CLAY SOIL,

Oxford Univ. (England). Soil Science Lab.
R. E. White.
Journal of Hydrology, Vol. 79, No. 1/2, p 21-35, July, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Unsteady flow, *Clay, *Model studies, Solute transport, Soil water, Mixing, Diffusion, Interstitial water, Bypass flow, Structured soils.

Solutions of 5 or 10 mM CaCl2 were applied at constant rates of 7-14 mm/hr to the surface of large (23-cm dia. x 20-24 cm long) undisturbed cores of cracking clay soil. Cl- breakthrough was analyzed assuming a log-normal distribution of solute travel times. The resultant transfer function model (TFM) fitted the data well for moist or

prewetted cores (volumetric water content theta sub i from 0.35 to 0.49) but was inadequate for very dry cores (theta sub i approximately = 0.30) at the higher input rates. When extensive bypass flow occurred in the soil, the probability density function of solute travel times was not well represented by a log-normal distribution. The breakthrough data were also analyzed using a mixing model which postulated convective mixing of applied solution with resident soil water to form a mobile miscible volume, and diffusion of solute between the miscible and immiscible volumes of soil water. This model was used to predict the miscible volume and its change with time during unsteady flow through each core. The time-weighted average fractional miscible volume theta' sub m derived from the mixing model was in close agreement with theta sub m, calculated as the input water flux divided by the mean pore-water velocity given by the TFM. An essential feature of any model of solute transport in structured soils is the recognition of two domains of different flow characteristics which is some cases give rise to a log-normal distribution of pore-water velocities. (Author's abstract)
W86-01654

MODEL FOR NITRATE LEACHING IN UNDISTURBED STRUCTURED CLAY SOIL DURING UNSTEADY FLOW,
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 5B.
W86-01655

SCALING THE EXPONENTIAL SOIL-WATER DIFFUSIVITY FOR SOILS FROM GHANA,
Ghana Univ., Legon. Dept. of Soil Science.
K. B. Laryea, and S. Abbenney-Mickson.
Journal of Hydrology, Vol. 79, No. 1/2, p 95-106, July, 1985. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Soil water, *Diffusivity, *Ghana, Infiltration, Mathematical equations, Soil type, Soil physical properties, Wetting.

Horizontal infiltration experiments were conducted on laboratory packed columns of six tropical soils chosen from two different ecological zones of Ghana (the coastal savannah and the forest regions). Calculated soil-water diffusivities of these soils were then fitted with an exponential regression equation to determine the values of the 'Universal' constants, alpha, gamma and beta. The scaling procedures suggested in the literature appear to be applicable to soils from Ghana. The constants alpha, beta and gamma vary according to the type of soil, sodium absorption ratio, and the scaling technique used to obtain the dimensionless soil-water diffusivity. Values obtained for alpha, gamma, and beta for these soils did not agree with those previously suggested, thus negating the proposed universality concept. The shape factor delta for the wetting profile appears to be around 0.90. (Moore-IVI)
W86-01659

INFLUENCE OF CYLINDRICAL MACROPORES ON STEADY-STATE INFILTRATION IN A SOIL UNDER PASTURE,
Sydney Univ. (Australia). Dept. of Soil Science.
K. R. J. Smettem, and N. Collis-George.
Journal of Hydrology, Vol. 79, No. 1/2, p 107-114, July, 1985. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Infiltration, *Macropores, *Pastures, Permeability coefficient, Infiltrometers, Steady-state infiltration.

Steady-state infiltration rates in a soil under native pasture were predicted from independent measurements of macropore volume fluxes and soil matrix hydraulic conductivity (K(sat)). K(sat) was measured by two methods which give slightly different results but were lower than areally averaged macropore fluxes. The predicted steady-state infiltration rates were compared with data obtained from cylinder infiltrometer measurements and agreement was excellent, indicating that steady-state infiltration was controlled primarily by the size and number of macropores within an infiltrometer ring. (Author's abstract)
W86-01660

PREDICTION OF STEADY-STATE PONDED INFILTRATION DISTRIBUTIONS IN A SOIL WITH VERTICAL MACROPORES,
Sydney Univ. (Australia). Dept. of Soil Science.
K. R. J. Smettem, and N. Collis-George.
Journal of Hydrology, Vol. 79, No. 1/2, p 115-122, July, 1985. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Infiltration, *Macropores, *Ponding, Simulation, Infiltrometers, Soil water, Permeability coefficient, Mathematical models, Soil properties.

A Monte Carlo simulation is used to predict the distributions of steady-state infiltration rate values for different infiltrometer ring sizes in a soil with vertical macropores. The simulation requires functional characterization of flow in soil macropores, coupled with a knowledge of macropore spatial dispersion. An additional option includes soil matrix hydraulic conductivity K(sat) which is assumed to be normally distributed with a known mean and standard deviation. The model was checked against measured data for two different ring sizes (0.071 and 0.0022 sq m) and good agreement was obtained. It is shown that in soil with vertical transmission macropores, the distribution of steady-state infiltration rate values becomes increasingly skewed as ring size is decreased, unless K(sat) is of sufficient magnitude to mask the macropore contribution. A method for determining the probability of a sensor with a known horizontal cross-sectional soil contact area intercepting at least one macropore is also presented. (Author's abstract)
W86-01661

LEACHING FRACTION BEYOND DEPTH X, CAUSED BY PERCOLATION OF A SOIL PROFILE WITH AN INITIAL SALT ACCMULATION AT ITS SURFACE,
Central Soil Salinity Research Inst., Karnal (India).
S. K. Gupta, D. Ramadurgaiah, and W. H. Van Der Molen.
Journal of Hydrology, Vol. 79, p 123-126, 1985. 1 Ref.

Descriptors: *Leaching, *Soil water, *Path of pollutants, *Percolation, Saline soils, Salts, Solute transport.

In many saline soils, large amounts of soluble substances are accumulated at the surface by capillary rise followed by evaporation. If such a soil is leached by rainfall or by application of irrigation water, these accumulated salts will move downward. By sampling the soil after a certain time, the concentration depth relation is obtained which can be used to find the parameters describing the leaching process. A characteristic for the progress made in leaching is the fraction of solute that moved beyond a certain depth x at the moment of sampling. An expression is derived for the leaching of a profile with a superficial accumulation of soluble substances. Use has been made of existing analytical solutions, now adapted to a Dirac delta function input of solute. With the concentration profile obtained, a formula follows for the fraction of solute leached beyond depth x at a given time t. (Baker-IVI)
W86-01662

OPERATIONAL RANGES FOR SUCTION LYSIMETERS,
Kaman Tempo, Santa Barbara, CA.
L. G. Everett, and L. G. McMillion.
Ground Water Monitoring Review, Vol. 5, No. 3, p 51-60, 1985. 12 Fig, 36 Ref. EPA contract 68-03-3090.

Descriptors: *Suction lysimeters, *Lysimeters, *Monitoring, *Aeration zone, Vadose water, Land treatment, Waste disposal, Soil water.

Four questions relative to suction lysimeter performance have been raised by operators of land treatment systems. These questions deal with plugging of the porous segments of the lysimeters, soil suction operational ranges, adsorption onto and screening by the materials comprising the various lysimeter parts, and loss of volatile organics under negative pressures. The physical operation of a lysimeter, the characteristics of the lysimeters tested (high- and low-flow lysimeters with porous ceramic cups and lysimeters with porous PTFE (polytetrafluoroethylene) cups, and procedures followed in preparing them for testing are all described and the results of experiments dealing with the first two questions - plugging and operational ranges - are discussed. The intake rate of suction lysimeters placed in the vadose zone, in most types of soils, will initially drop off rapidly, but will stabilize after about 15 liters of moisture have been drawn through the porous cups. Packing a crystalline silica flour slurry around the cups of PTFE lysimeters negates most of the plugging associated with finer particles in soils. The effective operating range of ceramic lysimeters is between 0 and 60 centibars of suction independent of the use of silica flour. The operating range of PTFE lysimeters without silica flour is extremely narrow, but with the use of silica flour is extended to about 7 centibars of suction. The testing program indicates that all lysimeters should be checked for leaks using pressure techniques before field installation and that lysimeters have 'dead' spaces, or reservoirs of from 34 to 80 mL of moisture that cannot be extracted from the cups, which must be taken into account when determining moisture collection rates. Information gathered in the test program is planned for inclusion in an EPA guidance document entitled 'Unsaturated Zone Monitoring at Hazardous Waste Land Treatment Units'. (Author's abstract)
W86-01697

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,
Woodward-Clyde Consultants, Santa Ana, CA.
For primary bibliographic entry see Field 7B.
W86-01701

REDISTRIBUTION OF BROMIDE BY RAINFALL INFILTRATION INTO A CECIL SANDY LOAM LANDSCAPE,
Agricultural Research Service, Watkinsville, GA.
For primary bibliographic entry see Field 5B.
W86-01716

EFFECTS OF TEMPERATURE, RAINFALL AND SOIL MOISTURE ON SOIL RESPIRATION AND LITTER DECOMPOSITION IN A SUB-TROPICAL HUMID FOREST ECOSYSTEM,
North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
J. Singh.
Acta Botanica Indica, Vol. 12, p 167-173, 1984. 3 Fig, 1 Tab, 26 Ref.

Descriptors: *Lailad, *India, *Forests, *Soil respiration, *Decomposition, *Litter, *Rainfall, *Soil water, Carbon dioxide, Nutrients, Climate, Seasonal variation, Temperature effects, Subtropic zone, Leaching.

The study was conducted at Lailad, in a mixed sub-tropical humid 50 yr old forest ecosystem developed subsequent to slash and burn agriculture in north eastern India. Carbon dioxide production was highly correlated with temperature, rainfall and soil moisture. Seasonal climatic conditions during the present study seem to play an important role in controlling the decomposition rates. The highest decomposition rates during rainy season indicated to the favorable effect of the availability of suitable temperature and moisture conditions on the activity of decomposers for leaching of water soluble substances. The low temperature and moisture conditions during winter had an unfavorable effect on the activity of decomposers resulting in lower rates of decomposition. The differences in weight loss in different species can be explained by considering the variation of water soluble components and the physical nature of the plant materials. (Baker-IVI)
W86-01759

STABILITY ANALYSIS OF WATER MOVEMENT IN UNSATURATED POROUS MATERIALS; 3. EXPERIMENTAL STUDIES,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
G. A. Diment, and K. K. Watson.
Water Resources Research, Vol. 21, No. 7, p 979-984, July, 1985. 5 Fig, 11 Ref.

Descriptors: *Porous media, *Soil water, *Infiltration, Particle size, Water content, Wetting front, Frontal instability, Hydrodynamics.

In the first paper of this series a detailed theory was presented in which the principles of hydrodynamic stability analysis were used to develop a linear perturbation equation for vertical water movement with nonsharp fronts. The second paper of the series discussed the application of this analysis to the stability of several soil water systems, some of which were potentially unstable. These included redistribution following infiltration, infiltration into a scale heterogeneous medium, and infiltration into a fine-over-coarse stratified profile. Although instability was expected for these systems and a noticeable trend toward instability was present, the numerical results did not predict the occurrence of such a condition. There was evidence to suggest that small amounts of initial water could have a significant effect on the damping out of instabilities that would occur under dry initial conditions. The present paper studies the effect of initial water content and grain size on wetting front instability by using a series of simple experiments. Results are presented for redistribution following infiltration for three porous materials, initially in a dry condition, and for three wetting depths prior to the onset of the redistribution phase. In addition, for the coarsest of these porous materials, a similar series of infiltration-redistribution experiments is conducted with varying amounts of initial water present. Results are also presented for the effect of initial water content of infiltration into a stratified profile. The experiments show quite clearly that even small amounts of initial water have a strongly inhibiting effect on the development of frontal instability patterns. (Author's abstract)
W86-01769

KINEMATIC WAVE APPROXIMATION TO INFILTRATION INTO SOILS WITH SORBING MACROPORES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
P. F. Germann, and K. Beven.
Water Resources Research, Vol. 21, No. 7, p 990-996, July, 1985. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Kinematic wave theory, *Infiltration, *Macropores, Soil water, Mathematical models, Sorption, Capillarity, Gravity flow, Wetting front, Soil hydraulic properties.

Soil macropores, such as dessication cracks and channels formed by roots and soil animals, are important pathways for water and solutes. Macropore flow is approached in this study by kinematic wave theory, including a sink function with regard to macropore flow due to sorption by the surrounding soil matrix. Infiltration into soils with macropores is treated as two-domain flow. The first domain is the soil matrix, in which water is subjected to capillarity, and infiltration is approached by Philip's sorptivity concept. The second domain is the soil macropore system in which water moves only under gravity and flow is approached by kinematic wave theory. The two-domain flow model is then applied to infiltration into a block of undisturbed soil containing macropores. There is faily good agreement between the modeled and the observed hydrograph. Only 18 trials were needed to match the modeled cumulative drainage to the observed one. It is assumed in the model that a uniform macropore system exists through which the wetting front may move as a piston. A multitude of flow paths each of them having its own macropore flow properties might prove to be a more realistic approach to macropore flow. This may account for the dispersion of the wetting and draining fronts. The dispersion may also account for the deviation of the modeled for the observed peak, because faster responding macropores were already drained at the time the model predicted the peak. (Moore-IVI)
W86-01771

DISCRIMINATION OF SOIL PHYSICAL PARAMETERS, THERMAL INERTIA, AND SOIL MOISTURE FROM DIURNAL SURFACE TEMPERATURE FLUCTUATIONS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
A. A. van de Griend, P. J. Camillo, and R. J. Gurney.
Water Resources Research, Vol. 21, No. 7, p 997-1009, July, 1985. 12 Fig, 1 Tab, 41 Ref. NASA contract NAS5-23450.

Descriptors: *Soil physical properties, *Soil water, *Thermal inertia, *Soil temperature, Model studies, Remote sensing, Soil surface temperature, Heat flux, Transpiration.

A coupled heat and moisture flux model was used to study the influence of soil physical parameters and moisture content on diurnal surface temperature fluctuations. The study was performed for a grass cover under summer and autumn conditions for four soil types, ranging from sand to clay. The results show that it may be possible to use the daily maximum and minimum surface temperature measurements to discriminate several soil physical characteristics, including soil moisture. Further, ignoring the lower boundary heat flux, as is usually done in thermal inertia mapping but which can vary substantially in relation to different hydrological recharge and discharge areas, may lead to significant errors in the interpretation of soil moisture, thermal inertia, and transpiration. (Author's abstract)
W86-01772

APPROXIMATE ANALYSIS OF THE BOREHOLE PERMEAMETER IN UNSATURATED SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research, Vol 21, No. 7, p 1025-1033, July, 1985. 10 Fig, 1 Tab, 21 Ref.

Descriptors: *Borehole permeameters, *Mathematical models, *Unsaturated flow, Permeameters, Unsaturated zone, Soil water, Permeability coefficient, Capillarity, Saturated zone.

An approximate analysis of the steady constant-head uncased borehole permeameter in homogeneous unsaturated soil is presented. A bulb-shaped region of saturated soil, the 'saturated bulb,' adjoins the water-filled length of the hole. The problem is solved by matching approximate models of the 'inner' saturated flow within the bulb and of the 'outer' flow in surrounding unsaturated soil. The quasilinear analysis, with sorptive number alpha characterizing the capillary properties of the soil, is applied to the outer saturated flow. Certain approximations made are geometrical, and other simplify the physics by treating gravity and capillarity as separable. The results agree well with the limited body of relevant detailed numerical solutions, and the model is consistent also with saturated flow results and formulae. In general, the capillary properties of the soil cannot be ignored: for a borehole of radius 0.05 m, the error committed in ignoring capillarity increases from 2.8 to 280% as alpha decreases from 10 to 0.1/m. The concepts and methods (the saturated bulb, use of the quasilinear analysis, matching inner and outer flows) apply to a range of steady mixed saturated-unsaturated flow systems with water applied under positive hydrostatic pressure to an initially unsaturated soil mass. The study leads to some doubt about the practicality of using the borehole permeameter to measure saturated hydraulic conductivity in the absence of an independent determination of alpha. (Author's abstract)
W86-01774

SUMMER SOIL MOISTURE CONTENT AND THE WATER TABLE IN A FORESTED WETLAND PEAT,
Toronto Univ. (Ontario). Dept. of Geography.
D. S. Munro.
Canadian Journal of Forest Research, Vol. 14, No. 3, p 331-335, June, 1984. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Soil water, *Water table, *Peat, *Wetlands, Beverly Swamp, Ontario, Soil moisture deficiency, Storage capacity, Swamps.

Soil samples were collected from the peat of the Beverly Swamp (Ontario), at weekly intervals, over three successive summers. The samples were analyzed to determine the distribution of soil moisture within the peat above the water table. A calculation scheme for the soil moisture deficit is defined and utilized to describe the behavior of the soil moisture regime over time. Linear regressions of soil moisture deficit against water table level are found to be statistically strong, but the slopes of the regressions change significantly from one summer to the next. Therefore, it is concluded that the position of the water table is not necessarily consistant indicator of storage capacity in wetlands. (Author's abstract)
W86-01779

EFFECT OF ENTRAPPED AIR ON WATER PERMEABILITY OF SOILS (THEORY AND EXPERIMENT),
Kiev State Univ. (USSR).
B. A. Faibishenko.
Water Resources, Vol. 11, No. 4, p 304-315, July-August, 1985. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Soil moisture, *Permeability coefficient, *Entrapped air, Unsaturated soils, Aeration, Water table, Model studies, Computers, Percolation.

The permeability of soils can be substantially affected by entrapped air, which remains in unsaturated soils of the zone of aeration and in quasi-saturated soils of the aquifer, reducing their permeability coefficient by 100 times and more. A model incorporating a system of equations should be used to predict water transport with consideration of entrapped air with a computer. For drainage conditions it is advisable to use in the zone of seasonal water table fluctuations in hydrogeological calculation the permeability coefficient and function K determined at the maximum possible volume of entrapped air for the investigated soils. Processes for moisture transport and percolation in the case of complete saturation and in a quasi-saturated state are described by one differential equation, the parameters of which vary for a different degree and character of soil saturation. During intake of water in monoliths under lab conditions and in rings and pits under field conditions the general character of variation of soil permeability with time is the same. Field methods can be used for determining the permeability coefficient of soils only with monitoring of the volume of entrapped air and spatial dynamics of water in soils. For practical purposes a combined approach can be recommended, which calls for: a field experiment - water intake tests in a pit for establishing the regularities of formation of the flow under natural conditions; a laboratory experiment - experiments on monoliths for determining the permeability coefficient as a function of the volume of entrapped air and hydrophysical properties of the soils and a computational experiment on a computer using a model for substantiating the necessary amount of field and lab works and for selecting and evaluating the correspondence of the mathematical model used to the natural process of percolation and moisture transport. (Baker-IVI)
W86-01804

ESTIMATION OF THE DEGREE OF DRAINAGE OF A TERRITORY,
Industrial and Scientific-Research Inst. for Engineering Surveys in Construction, Moscow (USSR).
V. V. Vedernikov, and E. S. Dzektser.
Water Resources, Vol. 11, No. 3, p 217-223, May-

June, 1984. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 3, p 60-67, May-June, 1984.

Descriptors: *Drainage, *Mapping, *Hydrogeology, Groundwater, Hydrology, Mathematical equations, Geomorphology, Climate.

The degree of drainage of a territory is one of the most important complex hydrogeologic characteristics. The construction of hydrogeologic maps with zones of various degrees of drainage is widely used in reclamation engineering. An estimation of the degree of drainage of territories is important for planning cities, industrial complexes, routes of oil and gas pipelines or when developing areas for industrial and civil construction. The degree of drainage of a territory depends on a whole set of conditions: geomorphologic, hydrogeologic, geologic, and hydrologic-climatic. The proposed method, based on quantitative drainage criteria, broadens the limits of applicability of existing methods in view of the comparatively greater detail of the natural conditions of the investigated territories and possibilities for future use. (Baker-IVI)
W86-01821

COMPARISON OF THREE FIELD METHODS FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. M. Lee, W. D. Reynolds, D. E. Elrick, and B. E. Clothier.
Canadian Journal of Soil Science, Vol. 65, p 563-573, August, 1985. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Permeability coefficient, *Permeameters, Measuring instruments, Sand, Loam, Clay, Macropores, Air entrapment, Soil type, Statistical studies.

The saturated hydraulic conductivity, Ks, was measured on a loamy sand, a fine sandy loam, a silt loam and a clay at four 100-sq m-area sites in southern Ontario. Twenty measurements of Ks, were obtained by each of three different measurement techniques at each of the four sites. The techniques included: (1) the air-entry permeameter method; (2) the constant head well permeameter method using the Guelph Permeameter; and (3) the falling-head permeameter method applied to small soil cores. The Ks data were found to be better described by the log-normal frequency distribution than by the normal frequency distribution. Statistical comparison of the mean Ks values (Ks) indicated significant differences between some or all of the methods within each site. This site-method interaction was interpreted in terms of the influence of macropores and air entrapment on each of the measurement techniques. The measured Ks values ranged over an order of magnitude on the sand, one to two orders of magnitude on the loams, and three orders of magnitude on the clay. The Ks estimates averaged over the three methods were: 0.00003 m/s for the sand; 0.000002 m/s for the loams and 0.0000001 m/s for the clay. Although all techniques were able to discriminate between the three soil types, the best choice of method for any particular situation appears dependent on the required type and accuracy of the Ks measurement, soil type, and the various practical constraints on the investigation. (Author's abstract)
W86-01909

2H. Lakes

POSSIBILITIES OF OBTAINING ZOOPLANKTON FROM THE RIVER PLONIA TO FEED YOUNG FISH,
Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrozoology.
B. Szlauer.
Acta Hydrobiologia, Vol. 25/26, No. 2, p 165-171, 1983/1984. 3 Tab, 12 Ref.

Descriptors: *Fish food, *Zooplankton, *River Plonia, *Poland, Fish, Aquaculture.

Little information is available on the occurrence of zooplankton at some distance from the outflows of rivers from lakes. A test method was proposed to elaborate on this problem which would allow the size of expected catches of zooplankton in a river to be estimated. Two sampling sites were chosen close to road bridges. Site I was 10 km from the outflow of the River Plonia from Lake Miedwie in a straight line. Site II was 18 km from this lake. The mean zooplankton flow at Sites I and II was respectively 74.86 and 57.88 kg wet weight per 24 hrs, ranging from 500 kg per 24 hr in May (Site I) to 0.32 kg/24 hr in August (Site II). During the period of demand for zooplankton, December to May, the zooplankton flow at Site I amounted to 23 310 kg. This was sufficient live food for the rearing of approximately 4000 kg of fry. The results of this study indicate it is possible to catch zooplankton in rivers flowing from lakes. This zooplankton may be caught even at a great distance from the lake, in those places most suitable from the point of view of their utilization. However, the catches may be abundant at such distant sites only in the period from November until May. (Baker-IVI)
W86-01320

EFFECT OF BIOTIC AND ABIOTIC FACTORS ON THE OCCURRENCE OF PLANKTONIC ROTIFERS (ROTATORIA) IN THE PLAWNIOWICE DUZE RESERVOIR (UPPER SILESIA, POLAND),
Silesian Univ., Katowice (Poland). Dept. of Zoology.
I. Bielanska-Grajner.
Acta Hydrobiologia, Vol. 25/26, No. 2, p 173-180, 1983/1984. 3 Fig, 26 Ref.

Descriptors: *Phytoplankton, *Reservoirs, *Plawniowice Duze Reservoir, *Poland, *Rotifers, Dissolved oxygen, Water temperature, Primary productivity, Population dynamics, Phytoplankton.

The Plawniowice Duze Reservoir lies in the Forest Protective Belt in the Upper Silesia Industrial Region of Poland. It was constructed by flooding a sand pit heading with waters from the Toszecki stream, a tributary of the River Klodnica. Filling was completed in 1975. The area of the reservoir is about 285 ha, with a maximum depth of 16 m, and a mean depth of 11 m. The Plawniowice Duze reservoir is a lowland, extremely limnic dam reservoir. The lake hollow is characterized by the absence of asymmetry typical for dam reservoirs. A hydrobiological investigation was carried out in the reservoir, which demonstrated a dependence between the occurrence of pelagic rotifers and phytoplankton appearing in the water body. The rotifers occurred in greater numbers at the same depths as the phytoplankton. A dependence was also noted between the vertical distibution of rotifers and the water temperature and the amount of dissolved oxygen in the water. (Baker-IVI)
W86-01321

EFFECTS OF ANNUAL DRAINING ON WATER QUALITY AND PRODUCTION OF CHANNEL CATFISH IN PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 8I.
W86-01322

APPROACH TO THE RESTORATION OF AQUATIC VEGETATION IN THE XIHU LAKE OF HANGZHOU, WITH REFERENCE TO THE WATER QUALITY PROBLEM (IN CHINESE),
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W86-01324

HABITAT REQUIREMENTS AND BIOINDICATOR VALUE OF THE MAIN COMMUNITIES OF AQUATIC VEGETATION IN NORTH-EAST POLAND,
Warsaw Univ. (Poland). Dept .of Phytogeography.
S. Klosowski.
Polskie Archiwum Hydrobiologii, Vol. 32, No 1, p 7-29, 1985. 6 Fig, 3 Tab, 37 Ref.

Descriptors: *Bioindicators, *Poland, *Aquatic vegetation, *Macrophytes, *Habitats, Pondweed, Indicators, Aquatic habitats, Nutrients.

Comparison of the phytosociological data as well as of the physical and chemical properties of water and substrate of the phytocenoses of five aquatic communities - Potamogetonetum perfoliati, P. lucentis, P. natantis, Nupharo-Nymphaeetum albae and Hydrocharitetum morsus-ranae - indicates that the properties of the habitat evidently influence phytosociological differentiation of the communities. The substrate and water represent two, in a great measure independent, habitat components whose importance for the various communities is different. Nearly each aquatic vegetation community, singled out on the grounds of floristic dominance, exhibits some indicator value. With respect to aquatic habitat, the greatest bioindicator value is displayed by Potamogetonetum natantis which is indicative of waters relatively poor in nutrients (mesotrophic water). (Author's abstract)
W86-01326

SEASONAL OBSERVATIONS OF HETEROTROPHIC ACTIVITY AND ACTIVE BACTERIAL NUMBER IN LAKE CONSTANCE,
Shinshu Univ., Matsumoto (Japan). School of Allied Medical Sciences.
K. Kato.
Archive fur Hydrobiologie, Suppl. 66, No. 3, p 309-319, May, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Seasonal variation, *Primary productivity, *Bacteria, *Lake Constance, Heterotrophic bacteria, Temperature effects, Phytoplankton, Eutrophication.

In situ experiments were conducted during 1982 to study factors regulating bacterial numbers and their heterotrophic activities in Lake Constance. Seasonal changes of heterotrophic activity and substrate-active bacterial number were determined using carbon-14 labeled glucose for samples taken from 2 m depths in the large mesotrophic lake. Glucose-active bacterial number fluctuated from 0.75 to 22000000 cells/ml and it amounted to between 3.5-46% of the total bacteria present which varied between 2.1 and 9800000 cells/ml. Vmax was low in April and increased rapidly, parallel to the spring bloom of phytoplankton. Turnover time of labeled glucose decreased from around 2 months (1336 h) to the order of days (182 h) in April and remained nearly constant at the level of a few days until 29 November when the numbers of turnover time and Vmax were 434 hr and 0.013 micro-g C/l/h, respectively. A close correlation was observed between Vmax and glucose-active bacterial number. Data show that both Vmax and specific Vmax were correlated with temperature. Bacterial response to labeled glucose did not show significant relations to primary productivity. (Baker-IVI)
W86-01329

SEDIMENT RESUSPENSION AND CURRENTS IN LAKE MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
B. C. Kenney.
Journal of Great Lakes Research, Vol. 11, No. 2, p 85-96, 1985. 7 Fig, 5 Tab, 18 Ref.

Descriptors: *Lake Manitoba, *Manitoba, *Suspended sediments, *Water currents, Sediments, Phosphorus, Nutrients, Stratification, Wind, Lakes.

Lake Manitoba is exposed to high prairie winds that produce both surface waves and turbulent lake currents. Large amounts of sediment are resuspended in the water column of the prairie lake. A device has been designed to collect samples of resuspended sediments in gram quantities at various depths without a fair weather bias. Although not thermally stratified, the currents measured in very shallow water in Lake Manitoba were frequently composed of a surface flow directly driven by the wind separated from a bottom layer by a large directional skew at the interface. The vertical mass distribution of resuspended sediment reflected the two layer characteristics of the lake currents.

The particle size distribution of the suspended sediment was also sharply layered with sand in the upper layer and silt in the lower. The resuspended sediments form a large phosphorus pool that is potentially available to support the immense algal blooms observed in prairie great lakes. (Baker-IVI)
W86-01341

CURRENTS AND TEMPERATURES IN GREEN BAY, LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. S. Miller, and J. H. Saylor.
Journal of Great Lakes Research, Vol. 11, No. 2, p 97-109, 1985. 8 Fig, 1 Tab, 18 Ref.

Descriptors: *Water currents, *Water temperature, *Green Bay, *Lake Michigan, Lakes, Water circulation, Water level, Thermal statification, Stratification, Waves.

Current and water temperature recordings made during 1977 constitute the first long term data set of this type from Green Bay. Anticlockwise water movements hypothesized from earlier indirect data were also indicated in the current data. Cool water flows southward along the western shore while warmer water returns in the eastern part of the bay. This cyclonic pattern is disrupted and reversed during northeasterly winds. An unexpected discovery was the large and consistent water volume transfer through Porte des Morts Passage and Rock Island Passage. Measurements showed the upper half of the water column egressing from the bay while cold hypolimnetic lake water entered the bay in the lower half. This intruding cold water, with an estimated flow rate of 3,300 cu m/sec during summer, supplies cool water well into the middle bay southward of Chambers Island. This cold-water inflow is not an infrequent episodic phenomenon, nor is the flow seasonally dependent. Flushing is enhanced dramatically by the infusion of additional water. Periodic components are present in all currents and are highly coherent with water level fluctuations. Currents through the mouth associated with water level oscillations at the bay head illustrated that the phase was constant within the frequency band of the semidiurnal tidal wave and co-oscillating 9 hr wave, contrary to model predictions. In addition, the phase of currents across the mouth was near zero for these oscillating components, suggesting that the modeled bottom friction may require adjustments. Three dimensional models capable of treating stratification and lake bay interactions are necessary to adequately model dynamic processes in Green Bay. (Baker-IVI)
W86-01342

PHYTOPLANKTON DISTRIBUTION IN SAGINAW BAY,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer, and E. Theriot.
Journal of Great Lakes Research, Vol. 11, No 2, p 132-142, 1985. 9 Fig, 5 Tab, 19 Ref.

Descriptors: *Phytoplankton, *Distribution, *Saginaw Bay, *Michigan, Great Lakes, Lake Huron, Multivariate analysis, Algae, Diatoms, Eutrophication, Population dynamics, Chlorophyta.

Saginaw Bay is located on the western side of Lake Huron, extending in a southwesterly direction from the lake into the lower peninsula of Michigan. Average conditions were measured in the phytoplankton assemblage in Saginaw Bay in order to examine movement of phytoplankton populations developing in the bay. Phytoplankton assemblage variation was also discussed in relation to proposed models of Saginaw Bay phytoplankton. Samples taken in the spring were numerically dominated by diatoms. However, green algae then took over for a brief period of dominance from July through October when diatoms again became the dominant taxonomic group. Cluster analysis indicated the bay could be effectively divided into two regions in regard to phytoplankton assemblages. The inner bay was typified by algal species with a Saginaw River origin and/or species typical of eutrophic waters in the Great Lakes. The outer region was typified in part by species of open Lake Huron. Unique phytoplankton assemblages were noted in Wild Fowl Bay and the area to the southwest of Oak Point. These areas are not well integrated with the rest of the bay. A possible strong nearshore effect was noted on transport of Saginaw Bay populations to Lake Huron. The nearshore effect modifies the effect of Saginaw River on the phytoplankton of the Saginaw Bay-Lake Huron system. (Baker-IVI)
W86-01345

TIME-DEPENDENT SOLUTION OF MULTI-SEGMENT MASS BALANCE MODELS OF CONTAMINANTS IN THE GREAT LAKES,
Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 5B.
W86-01350

PARTITIONING OF HEAVY METALS (FE, MN, CD, PB, CU, ZN, CO, NI AND AS) AND P INTO SELECTIVE CHEMICAL FRACTIONS IN SEDIMENTS FROM LAKE KOJIMA (IN JAPANESE),
For primary bibliographic entry see Field 5B.
W86-01362

POPULATION DYNAMICS OF THE DEVILS HOLE PUPFISH,
Michigan Univ., Ann Arbor. School of Natural Resources.
B. Chernoff.
Environmental Biology of Fishes, Vol. 13, No. 2, p 139-147, 1985. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Population dynamics, *Devils Hole, *Nevada, *Pupfish, Model studies, Fish, Model studies, Mortality, Simulation, Water level, Seasonal variation.

A model is constructed to simulate fluctuations in monthly population sizes of the Devils Hole pupfish between January 1973 and August 1976. The strength of the proposed conceptual model is that is allows focusing on the relationship between population size and various biological and environmental factors. The model is shown to be capable of accurately predicting the population size over a 44 month period when several sources of mortality were included. The model was unable to project the long term effect of constant water-level management. The model should not be considered as an end in itself but rather as a valuable heuristic tool which can shed light on areas of needed research. A variety of biological parameters are estimated, and adult mortality is partitioned into natural and environmentally-dependent components. The simulations capture the seasonal fluctuations in population size, and only seven predicted population sizes differ from those observed by 20% or more. The model is used to make testable predictions about the life history of this species and interactions of the parameters are discussed. (Baker-IVI)
W86-01364

MIXED LAYER DYNAMICS IN A LAKE EXPOSED TO A SPATIALLY VARIABLE WIND FIELD,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. Imberger, and G. Parker.
Limnology and Oceanography, Vol. 30, No. 3, p 473-488, May, 1985. 17 Fig, 1 Tab, 18 Ref. Australian Water Resources Council project 80/119.

Descriptors: *Lakes, *Mixing, *Wind velocity, Lake circulation, Water circulation, Salinity, Density, Water temperature.

The formation of frontal structures in the surface mixed layer near the entrance of an embayment in a medium-sized lake were described with field measurements. The observed evolution of the fronts was interpreted in terms of three well defined dynamical regimes. The first, differential heating, is defined as the variable heat capture due to decreased surface heat losses and warmer surface water in the sheltered embayments. The second, variable deepening of the mixed layer, is induced by a sudden increase in wind speed in the open central areas of the lake, with only minimal mixing in the sheltered part of the lake. The third is the horizontal gravitational motion driven by the horizontal density gradients set up by the active deepening of the mixed layer in the exposed parts of the lake. Although detailed wind data were not available, observations of the temperature and salinity fields show the existence of fronts in lakes and strongly suggest the importance of the above mechanisms in determining the horizontal variability of these fields in the surface mixed layer of medium-sized lakes. (Author's abstract)
W86-01412

EFFECTS OF PH AND PLANT SOURCE ON LIGNOCELLULOSE BIODEGRADATION RATES IN TWO WETLAND ECOSYSTEMS, THE OKEFENOKEE SWAMP AND A GEORGIA SALT MARSH,
Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 2L.
W86-01413

EXPERIMENTAL MANIPULATION OF NUTRIENTS AND WATER IN A FRESHWATER MARSH: EFFECTS ON BIOMASS, DECOMPOSITION, AND NUTRIENT ACCUMULATION,
Manitoba Univ., Winnipeg. Dept. of Botany.
For primary bibliographic entry see Field 5D.
W86-01414

PHOSPHORUS LIMITATION OF LOTIC PERIPHYTON GROWTH RATES: AN INTERSITE COMPARISON USING CONTINUOUS-FLOW TROUGHS (THOMAS RIVER SYSTEM, BRITISH COLUMBIA),
National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
M. L. Bothwell.
Limnology and Oceanography, Vol. 30, No. 3, p 527-542, May, 1985. 3 Fig, 7 Tab, 72 Ref.

Descriptors: *Phosphorus, *Limiting nutrients, *Periphyton, *Thomas River System, *British Columbia, Nitrogen, Nutrients, Growth, Biomass, Algae, Chemical composition.

Periphyton growth rates and relative degrees of phosphorus deficiency were compared with onsite, continuous-flow troughs in three parts of the Thompson River system. Soluble reactive phosphorus (SRP) in the lower Thompson, North Thompson, and South Thompson Rivers averaged 3.4, 1.1, and 0.7 micro-g/liter. Several physiological and chemical composition parameters ranked the degree of P deficiency in the rivers in the same sequence as did SRP. Among these were alkaline phosphatase activity, V sub max for (P-32)O4(3-) uptake, and cellular N:organic P, Chl a:ATP, C:ATP, and C:organic P. Specific growth rates (mu) estimated by biomass accrual and by (C-14)O2 uptake usually, but not always, indicated higher mu with greater availability of P. However, relative specific growth rates (mu:mu sub max) consistently reflected the influence of P limitation. As assessed from N:organic P and by application of the Droop and Goldman-Carpenter equations, mu:mu sub max was 0.8-0.9 at the lower Thompson, 0.3-0.6 at the North Thompson, and 0.0-0.3 at the South Thompson sites. Hence, periphyton growth rates in the lower Thompson River were near the maximum set by temperature and light at ambient SRP of only 3-4 micro-g/liter. Evidence of P-limited growth rates in the South Thompson and North Thompson Rivers was found at temperatures approaching 0 C. (Author's abstract)
W86-01416

FACTORS CONTROLLING PHOSPHORUS LIMITATION IN STREAM SEDIMENTS,
State Univ. of New York Coll. at Cortland. Dept. of Biological Sciences.
R. L. Klotz.
Limnology and Oceanography, Vol. 30, No. 3, p

543-553, May, 1985. 5 Fig, 6 Tab, 30 Ref.

Descriptors: *Phosphorus, *Limiting nutrients, *Stream sediments, *Sediments, *New York, Microorganisms, Benthos, Alkaline phosphatase activity, Forest watersheds, Agricultural watersheds.

Factors influencing the phosphorus limitation of benthic microorganisms were determined for four streams (two agricultural and two forested) in central New York State over an annual cycle. Phosphorus limitation was measured biweekly as specific alkaline phosphatase activity (APA) of sediment samples. Analysis of variance showed the forested streams (sites 2 and 4) to have significantly different sediment APA from the agricultural streams (sites 1 and 3), the higher APA for the forested sites indicating greater phosphorus limitation. Stream total reactive phosphorus concentrations showed no relationship with watershed type, with mean annual values of 10.5 and 6.0 micro-g/liter for agricultural sites 1 and 3 and 4.1 and 9.6 for forested sites 2 and 4. With all sites grouped together, sediment APA had a low correlation with stream water phosphate ($r = 0.184$, $n = 73$). Phosphorus sorption isotherms showed sediments from agricultural streams to have higher phosphate sorption indices than forested sites and to sorb rapidly large amounts of phosphorus. This resulted in higher available phosphorus content for the agricultural sediments and lower sediment APA. (Author's abstract)
W86-01417

DISTRIBUTION AND CHARACTERISTICS OF CARBOXYPEPTIDASE ACTIVITY IN POND, RIVER, AND SEAWATERS, IN THE VICINITY OF TOKYO,
Tokyo Univ. (Japan). Dept. of Chemistry.
S. Hashimoto, K. Fujiwara, K. Fuwa, and T. Saino.
Limnology and Oceanography, Vol. 30, No. 3, p 631-645, May, 1985. 10 Fig, 4 Tab, 29 Ref. Ministry of Science, Culture and Education (Japan) grant-in-aid 58540349.

Descriptors: *Carboxypeptidase, *Ponds, *Rivers, *Seawater, *Tokyo Bay, *Japan, *Enzymes, Chlorophyll, Proteins, Water chemistry, Peptides, Organic carbon.

Enzymatic hydrolysis of the peptide bond between glycine and tryptophan was measured in river water, pond water, and seawater near Tokyo. Enzymatic activities were in the range between 0.1 and 3 mU/liter, 10-50% of the activity was due to cell-free (dissolved) enzymes (1 mU expresses the rate of hydrolyzing substrate at 1 nM/min at 25 C). According to gel permeation chromatography, the dissolved activity included several macromolecules with molecular weights between 30,000 and 500,000 daltons. The horizontal and vertical distributions of this activity were measured in Tokyo Bay and the open sea, where an appreciable amount was detected even at 1,400-m depth. Among various factors investigated (including pH, salinity, water, temperature, metal ions, and phosphorus concentrations), total organic carbon, particulate organic carbon, and especially chlorophyll a were positively correlated to the enzymatic activity in Tokyo Bay. The slope of regressions of chlorophyll a on carboxypeptidase activity for individual sampling points showed that the activity per unit of chlorophyll a increased when the sampling station was closer to the open sea. Although whole protein molecules are not decomposed in the dissolved state, small peptides may be degraded by the free dissolved enzymes. (Author's abstract)
W86-01418

ANNUAL LOSSES OF IRON FROM MOORLAND SOILS AND THEIR RELATION TO FREE IRON CONTENTS,
Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Journal of Soil Science, Vol. 36, No. 2, p 307-312, June 1985. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Iron, *Moorland soils, *Soils, Chemical composition, Metals, Organic matter, Soil properties.

The temporal pattern of iron loss from a moorland catchment was investigated by intensive stream sampling. The field site was a 51 ha area of moorland in the Ochil Hills near Stirling, Scotland, drained by a small tributary of the Allan Water. Filtered water samples were used for the determination of dissolved iron by atomic absorption spectrophotometry and of dissolved organic matter by dichromate oxidation. Losses of iron from the catchment were calculated as the product of discharge and iron concentration, summed over time. The total loss in 1 year was 2.11 kg/ha of Fe, with a pronounced autumn maximum. Iron concentrations in stream water were strongly correlated with dissolved organic matter content, but again with seasonal variation. The autumn maximum for Fe losses relates to the flushing of DOM during autumn rewetting of the catchment. However, the DOM/Fe ratio indicates maximum iron transport per unit mass of DOM in the winter. Free iron content measured on a number of soils in the catchment ranged from 3.1 to 8.7 kg/sq m. Assuming soil development over 10,000 years, predicted loss of iron from the catchment is comparable in quantity to the amounts of free iron in soils. (Collier-IVI)
W86-01468

EFFECT OF SUSPENDED SOLIDS ON THE GROWTH OF APICAL TIPS OF GAMETOPHYTE PLANTS OF LEMANEA AND ON CARPOSPORE GERMINATION AND SUBSEQUENT COLONISATION,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 5C.
W86-01498

INTER- AND INTRA-HABITAT DISTRIBUTION OF LEECHES IN A EUTROPHIC ENGLISH LAKE,
Liverpool Univ. (England). Dept. of Zoology.
S. M. L. Randall, S. M. Spelling, and J. O. Young.
Archiv fur Hydrobiologie, Vol. 103, No. 4, p 419-444, June, 1985. 12 Fig, 9 Tab, 35 Ref.

Descriptors: *Leeches, *Ecological distribution, *Eutrophic lakes, *England, Habitats, Substrate, Reproduction, Biomass, Water depth, Migration.

In an eutrophic English lake, Erpobdella octoculata, Glossiphonia complanata and Helobdella stagnalis had their maximum abundance in waters of less than 1 m in depth. H. stagnalis was numerically dominant on stones, on plants and in detritus. E. octoculata had a greater relative abundance than G. complanata on plants and in detritus. For any one species, weight-structure and breeding activity were similar for populations living on stones and in beds of vegetation. Leeches showed no preference for stones of a particular size or texture. For each of the species, density and biomass were less but mean weight and the proportion of breeding animals were greater on stones than in the underlying subtratum. There was some evidence for a movement of leeches into the deeper littoral waters in the winter. (Author's abstract)
W86-01499

RESPONSES OF PHYTOPLANKTON IN LAKE JACARETINGA TO ENRICHMENT WITH NITROGEN AND PHOSPHORUS IN CONCENTRATIONS SIMILAR TO THOSE OF THE RIVER SOLIMOES (AMAZON, BRAZIL),
Universidade Estadual Paulista, Botucatu (Brazil). Inst. Basico de Biologia Medica e Agricola.
R. Henry, K. Hino, J. G. Tundisi, and J. S. B. Ribeiro.
Archiv fur Hydrobiologie, Vol 103, No. 4, p 453-477, June, 1985. 14 Fig, 4 Tab, 40 Ref. NSF grant BSR-800.3203.

Descriptors: *Phytoplankton, *Nitrogen, *Phosphorus, *Lake Jacaretinga, *River Solimoes, *Brazil, Zooplankton, Productivity, Nitrates, Chlorophyll, Decomposition, Bacteria.

The Amazon valley presents a large diversity of aquatic environments, all formed by water flowing from the Andes through the River Solimoes. The water inflow from the river Solimoes into the adjacent lakes (Lake Jacaretinga for example) affects strongly the ecology and productivity of the lacustrine systems. An in situ enrichment experiment was conducted in Lake Jacaretinga (Brazil) in January 1982 to assess the possible stimulation of phytoplankton growth by nutrients (nitrates or phosphates). Phosphate enrichment (with or without nitrate) did not cause statistically changes in the chlorophyll production. There was a significant increase in biomass (chlorophyll a) and photosynthetic activity after only two days incubation due to nitrate addition. On day four, a decrease in chlorophyll and primary productivity occurred. This reduction was explained as a function of predation by zooplankton. On day six of incubation, an increase in productivity was observed, due probably to ammonia excretion by zooplankton and decomposition action by bacteria. The inflow of river water into the lake at high water (April to September) results in a rich load of nutrients as well as an increase of the water levels in the lake. (Moore-IVI)
W86-01500

GAMMARIDS IN STREAMS OF NORTHEASTERN BAVARIA, F. R. G. I. PREDICTION OF THEIR GENERAL OCCURRENCE BY SELECTED HYDROCHEMICAL VARIABLES,
Fachhochschule Weihenstephan, Freising (Germany, F.R.). Fachbereich Landespflege.
E. Schrimpff, and F. Foeckler.
Archiv fur Hydrobiologie, Vol. 103, No. 4, p 479-495, June, 1985. 3 Fig, 7 Tab, 21 Ref.

Descriptors: *Gammarus, *Ecological distribution, *Bavaria, *Germany (Federal Republic), Calcium, Magnesium, Hydrogen ion concentration, Water chemistry, Geology, Crustaceans.

Northeastern Bavaria (Federal Republic of Germany) belongs to the distribution area of the two Gammarus species: G. fossarum and G. roeseli, but a geographical area of about 3000 sq km is not populated by gammarids. To determine if natural conditions or anthropogenic influences cause this, 143 stream sections within 15 selected streams in Northeastern Bavaria were checked for the presence of Gammarus, temperature, pH and electric conductivity. Water samples were analyzed for Ca, Mg, K, Cl(-), NO3(-), PO4(3-), Fe, Zn, total hardness and organic matter. The occurrence of gammarids in this area is restricted to the well buffered streams of the scarplands. Gammarids avoid the acidic waters, poor in ions, of the ancient earthblock area and of the ferrugineous sandstone areas within the scarplands. Mg, Ca, and pH were the hydrochemical parameters most efficient for discrimination between the occurrence and nonoccurrence of gammarids. A simple discriminatory model built up on these variables yields 96% correct predictions within Northeastern Bavaria. The model was less efficient when applied in other areas. (Moore-IVI)
W86-01501

LOWLAND HARDWOOD WETLAND INVERTEBRATE COMMUNITY AND PRODUCTION IN MISSOURI,
1027 Second St., Morgan City, LA, 70380.
D. C. White.
Archiv fur Hydrobiologie, Vol. 103, No. 4, p 509-533, June, 1985. 1 Fig, 13 Tab, 40 Ref.

Descriptors: *Wetlands, *Invertebrates, *Productivity, *Missouri, Isopods, Amphipods, Clams, Drought tolerance, Dissolved oxygen, Mixing, Climate.

The invertebrate community and production on 3 lowland hardwood wetland sites in southeastern Missouri, were studied in the winter of 1979-1980. The 1 managed and 2 naturally flooded sites varied in the initiation date of winter flooding. The invertebrate community was classified according to strategies for drought toleration and period or recruitment to the community. The dominance of

permanent residents (isopods, amphipods and fingernail clams) indicated that lowland hardwood wetlands retain sufficient moisture during the dry period to support animals with limited drought tolerance. Comparisons of isopod growth on the 3 sites indicated that duration of the hydroperiod was the most important factor affecting production. The relatively low production of isopods, amphipods and fingernail clams on lowland hardwood wetlands is related to limited dissolved oxygen, poor water mixing and a short, cold growing season. (Author's abstract)
W86-01502

SPY POND DIAGNOSTIC-FEASIBILITY STUDY: RECOMMENDATIONS FOR RESTORING A LAKE IMPACTED BY URBAN STORMWATER RUNOFF,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
E. W. Chesebrough, and C. L. Duerring.
Northeastern Environmental Science, Vol. 3, No. 2, p 59-66, 1984. 4 Fig, 1 Tab, 19 Ref.

Descriptors: *Spy Pond, *Arlington, *Massachusetts, *Eutrophic lakes, *Ponds, Lake restoration, Water pollution effects, Lakes, Water quality, Urban runoff, Oxygenation, Aluminum salts.

A diagnostic study was performed on Spy Pond in Arlington, Massachusetts from March 1980 to April 1981 by the Massachusetts Division of Water Pollution Control. This lake was found to be highly eutrophic based on high inlake nutrient concentrations, anaerobic hypolimnion during summer stratification, successive algae blooms, and dense aquatic macrophyte growth in littoral areas. Forty storm drains are known to deliver urban stormwater runoff to the lake and this was found to be a major source of nutrients. A feasibility study further examined and confirmed these results. A cost-effective restoration project was developed that incorporates the following components: importation of 1 mgd of groundwater, periodic use of an aluminum salt to seal the sediments, an oxygen diffuser to enhance circulation, and a diversion chamber at the major storm drain/inlet to direct inflows into three separate waste streams. (Author's abstract)
W86-01550

NUTRIENT CYCLING AND ECOSYSTEM BEHAVIOUR IN A SALT-WATER LAKE,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
I. De Vries, and C. F. Hopstaken.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 221-245, December, 1984. 6 Fig, 4 Tab, 46 Ref.

Descriptors: *Cycling nutrients, *Ecosystems, *Lakes, *Lake Grevelingen, *Netherlands, Water resources development, Flood control, Environmental effects.

A nutrient balance model is developed to describe and evaluate the relations between carbon cycling and nutrient dynamics in saline Lake Grevelingen, a former estuary in the SW-part of the Netherlands. Calculations indicate nutrient limitation of planktonic and benthic microalgae by reversible storage of more than 75% of the available silicon and nitrogen in bottom detritus. Mobilization from the bottom is the main nutrient source during summer. Uptake by benthic micro-algae strongly reduces the nutrient flux from shallow bottoms at that time. Uptake of nutrients from the overlaying water by benthic micro-algae during spring can explain the observed decrease of the dissolved silicon concentration in the absence of planktonic diatoms. The planktonic primary production depends on the balance between storage of nutrients in bottom detritus, mineralization, and uptake by benthic microalgae. Denitrification is considered to be a key process in the nitrogen balance, compensating the nitrogen load, and thus crucial in consolidating the mesotrophic properties of the lake. Factors probably influencing denitrification and hence controlling or promoting eutrophication in shallow marine ecosystem, like the oxygen concentration in the sediment and the suspension feed in bottom fauna community, are discussed. The observed gradual concentration decrease of silicon at an increasing nitrogen concentration, combined with a shift in phytoplankton from diatoms to flagellates, is explained by irreversible fixation of a small fraction of silicon in diatom tests, combined with a high resolution rate of the labile silicon fraction in detritus. (Baker-IVI)
W86-01569

PHYTOPLANKTON PRIMARY PRODUCTION IN BRACKISH LAKE GREVELINGEN (SW NETHERLANDS) DURING 1976-1981,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
F. Vegter, and P. R. M. de Visscher.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 246-259, December, 1984. 3 Fig, 4 Tab, 33 Ref.

Descriptors: *Water resources development, *Flood control, *Environmental effects, *Phytoplankton, *Primary productivity, *Lake Grevelingen, *Netherlands, Carbon, Nutrients, Temperature effects, Water temperature, Light intensity, Chlorophyll.

Phytoplankton primary production in brackish Lake Grevelingen was studied from 1976 to 1981, inclusive, in connection with a number of environmental parameters. An evident tendency of increasing primary production from 1978 (90 g C/sq m/a) to 1981 (225 g C/sq m/a) has been shown, following a change in the hydrological regime of the lake in 1978, viz. the opening of a sluice between the lake and the North Sea. Especially increased nitrate concentrations may be responsible for the enhanced production. Primary production was triggered almost every year at the end of February with prevailing light conditions of 0.002-0.004 J/sq cm/s in the water column. Annual production data from Lake Grevelingen are comparable with literature values, measured in eutrophicated coastal areas. (Baker-IVI)
W86-01570

CHANGES OF SEDIMENT DISTRIBUTION PATTERNS IN LAKE GREVELINGEN, AN ENCLOSED ESTUARY IN THE SW NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. Kelderman, J. Nieuwenhuize, A. M. Meerman-Van de Repe, and J. M. Van Liere.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 273-285, December, 1984. 8 Fig, 1 Tab, 29 Ref.

Descriptors: *Lake sediments, *Lake Grevelingen, *Netherlands, Environmental effects, Sedimentation, Sediment transport, Sediments, Particle size, Distribution.

Some basic sediment parameters from samples of 0 to 3 cm sediment depth were investigated at 430 stations in the recently formed Lake Grevelingen, to elucidate the history of sediment deposition in Lake Grevelingen and the former Grevelingen estuary. A geographical trend exists for the sediment median grain size, with increasing median grain size values towards the eastern part of the lake. This trend has been caused by sediment distribution processes under the former ebb and flood currents in the Grevelingen estuary. After enclosure of the estuary in 1971, much of the fine grained sediment material has been transported towards the deeper gullies. A reflection of this may be seen in the recent sediment maps for mud content and organic carbon content of the upper 0-3 cm sediment layer in Lake Grevelingen. (Baker-IVI)
W86-01571

SEDIMENT-WATER EXCHANGE IN LAKE GREVELINGEN UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. Kelderman.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 286-311, December, 1984. 11 Fig, 3 Tab, 69 Ref.

Descriptors: *Lake sediments, *Lake Grevelingen, *Netherlands, Sediments, Nutrients, Water temperature, Phosphates, Turbulence, Silicates, Resuspension, Model studies.

The impact of various environmental factors on the phosphate and silicate sediment-water exchange in Lake Grevelingen has been investigated in a series of laboratory experiments under aerobic conditions. Silicate mobilization from the sediment showed a strong temperature dependence, with fluxes ranging from 5 mg Si/sq m/day at 5 C to 85 mg Si/sq m/day at 20 C. Phosphate mobilization fluxes ranged from 0.5 to 11 PO4-P/sq m/day at 5 and at 20 C respectively. The phosphate exchange fluxes showed a significantly linear negative correlation with the phosphate concentrations in the overlying water, in accordance with Fick's first law of diffusion. High P accumulation rates into the sediment were especially found at low water temperatures. Resuspension of the upper sediment layer was shown to enhance these P accumulation rates even more. Based on the results for four different sediment types, general relationships have been derived for the phosphate sediment water exchange as a function of water temperature and phosphate concentration in Lake Grevelingen. The results have successfully been applied in a simulation model for the phosphate concentration in Lake Grevelingen over the years 1974 through 1977. (Baker-IVI)
W86-01572

NUTRIENT CONCENTRATIONS IN THE INTERSTITIAL WATER OF LAKE GREVELINGEN SEDIMENT: EFFECTS OF SEDIMENT REDISTRIBUTION AND BENTHIC PRIMARY PRODUCTION PROCESSES,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. Kelderman.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 312-326, December, 1984. 7 Fig, 2 Tab, 75 Ref.

Descriptors: *Netherlands, *Lake Grevelingen, *Sediments, *Nutrients, *Interstitial water, Benthos, Primary productivity, Oxygen, Sedimentation, Ammonia, Nitrates, Phosphorus, Silicates, Water depth.

Interstitial water characteristics are a useful indicator for the various diagenetic processes in the sediment. Nutrient concentrations in the interstitial water were periodically investigated at 24 permanent stations in Lake Grevelingen, a recently enclosed estuary in the Netherlands. At the deeper stations (>7 m) in the lake, phosphate and silicate pore water concentration generally reach maximum values in the 0-3 cm sediment zone (typically 50 and 400 microgat/l respectively). These maxima are caused by the mineralization of reactive sediment material, that is continuously being redistributed towards the deeper areas in the lake. At the shallow stations (<7 m) local phosphate and silicate porewater maxima are often found in the top 0-1 or even 0-.5 cm layer. It is probable that mineralization of microphytobenthos cells plays a dominant role here. This implies that a light dependent nutrient depletion in the upper mm, or less, of the sediment must have occurred; an effect that could not be detected with the present interstitial water sampling technique, but has indirectly been shown to take place at a field station with high microphytobenthos primary production rates. Highly significant seasonal trends were found for the P, Si and NH4-N pore water concentration in the top layer at the deeper stations. Seasonal variations at the shallow station were virtually absent; light regime, and not temperature, may be the dominant factor here. (Baker-IVI)
W86-01573

CARBON FIXATION AND CHLOROPHYLL IN BOTTOM SEDIMENTS OF BRACKISH LAKE GREVELINGEN, THE NETHERLANDS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. H. Nienhuis, and B. H. H. De Bree.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 337-359, December, 1984. 5 Fig, 6 Tab, 44 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Lake sediments, *Carbon fixation, Chlorophyll, Bottom sediments, Pigments, Particulates, Organic carbon, Primary productivity, Benthos.

Chlorophyll a concentrations in the upper 10 cm (sliced per cm) of Lake Grevelingen (Netherlands) sediments are given for the years 1977-1980. Chlorophyll a in the upper cm of the bottom varied between 20-400 mg/sq m. Average values in 1-3 m deep sandy and silty-sandy stations amounted to 67.5-82.2 mg/sq m in the upper cm. A 7 m deep silty station contained on an average 42.7 mg/sq m chlorophyll a in the upper cm of the sediment. Both within year and year to year variations were large. A restricted number of phaeopigment data for 1977 revealed an average phaeopigment chlorophyll a ratio of 0.03 (sand) to 0.39 (silt). Particulate organic carbon (POC) measured in 1977 and 1978 in the top cm of the sediment showed annual average values ranging between 0.2 and 0.7% of sediment dry weight. C-14 fixation data in the light, as measured in a lab incubator, are given for 1979 and 1980, with highest values during summer and lower values in winter. Integrated annual values give average C-14 fixation estimates per station ranging between 47 and 71 g C/sq m/a, with a variation coefficient of 35 to 49% of the mean. Average C-14 dark fixation values varied between 13 and 27% of average light fixation values. An arbitrarily and tentatively derived net microphytobenthos primary production estimate for entire Lake Grevelingen amounts to 35 g C/sq m for 1979 and 32 g C/sq m for 1980. The relationship between POC and chlorophyll a concentration was sometimes significant; between annual chlorophyll a concentration and light fixation values it was not. The C-14 and the oxygen exchange methods both have serious drawbacks when applied to benthic systems. (Baker-IVI)
W86-01574

DYNAMICS, MIGRATION AND GROWTH OF NASSARIUS RETICULATUS (MOLLUSCA: PROSOBRANCHIA) COLONIZING SALINE LAKE GREVELINGEN (SW NETHERLANDS),
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
R. H. D. Lambeck.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 395-417, December, 1984. 13 Fig, 3 Tab, 17 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Snails, *Biomass, Growth rates, Population dynamics, Lakes, Migration.

The marine snail Nassarius reticulatus colonized Lake Grevelingen (Netherlands) after its creation in 1971. A population explosion took place in 1976. Dynamics, growth and biomass development were studied during 1976 and 1977. One generation a year was observed, with 1976 settlement around August 1. Densities at a 12 m deep station were mostly below 10/sq m, at two shallow (1 m) stations numbers increased to 40 to 60 sq m, as a result of immigration. Numbers at two 3 m stations, with peak values of 200 sq m, showed a cyclic pattern with a minimum in July 1977 due to migratory movements. Biomass increased over the period of investigation. The lowest maximum biomass was found at 12 m (0.16 g ADW/sq m) and the highest of 5.0 g at a 3 m station. In this survey the dominant 1976 year class showed a gradual decline from about 300 ind/sq m between 2 and 35 m to about 60/sq m in water deeper than 10 m. Growth rates were also depth dependent. Within the range of 2 to 25 m juveniles born in 1976 showed a maximum mean size of 6.8 mm after one growing season at 5 to 6 m depth against only 3.5 mm in deep water. Highest mean values after 2 growing seasons, vix. 16 mm, were reached at the 1 m deep stations, which figure might be inflated by size dependent immigration. Growth was poor (8 mm) at the 12 m station. Growth rates are similar to Swedish observations, but were reached at 10 to 50 times higher densities in Lake Grevelingen. (Baker-IVI)
W86-01575

LONG-TERM EVOLUTION OF THE MEIOFAUNA AT A SANDY STATION IN LAKE GREVELINGEN, THE NETHERLANDS,
Ghent Rijksuniversiteit (Belgium). Zoology Inst.
K. A. Willems, Y. Sharma, C. Heip, and A. J. J. Sandee.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 418-433, December, 1984. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Population dynamics, *Nematodes, *Copepods, Crustaceans, Species diversity, Species composition, Biomass, Vertical distribution.

Data on density, diversity and species number of harpacticoids and nematodes from a 3 m deep station in Lake Grevelingen are reported over the period 1975-1980. Vertical distribution of both copepod and nematode densities are added. Over the 6 year period 95 species of nematodes and 26 species of harpacticoids have been identified. Neither diversity nor species number of harpacticoids changed significantly over the period. Nematode diversity and species number showed considerable changes, and especially the species composition evolved drastically over the years. The changes in feeding types among nematodes are discussed. Densities of both copepods and nematodes changed substantially over the 6 year period. Concurrent with a significant rise of the redox discontinuity layer from more than 20 cm sediment depth to less than 5 cm, the interstitial copepod fauna disappeared almost completely. The changes in vertical distribution of nematode densities were less pronounced though substantial. (Baker-IVI)
W86-01576

DENSITY, GROWTH AND ANNUAL FOOD CONSUMPTION OF PLAICE (PLEURONECTES PLATESSA L.) AND FLOUNDER (PLATICHTHYS FELSUS (L.)) IN LAKE GREVELINGEN, THE NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
G. Doornbos, and F. Twisk.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 434-456, December, 1984. 6 Fig, 7 Tab, 34 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Population dynamics, *Fish, Plaice, Flounder, Saline lakes, Growth, Fish food.

Within the scope of a carbon budget study in the 108 sq km saline Lake Grevelingen, investigations on the plaice and flounder populations were made during October 1979 to December 1981. Both populations were dominated by the 1979 year class that presumably entered the lake as larvae in the year the Brouwerssluice, which opens to the North Sea, was operative the whole year round. Due to high summer temperatures in the lake, juvenile plaice attained a mean length of 13.0 cm and a fresh weight of 27.4 g at the end of their first growing season. Total stock of plaice, excluding year class 1981, was estimated at an average of 1.3 million over 1980 and at 0.6 million fish over 1981. About 56% of the plaice food consisted of polychaetes, mainly consisting of in 1980 Arenicola marina (41%) and in 1981 A. marine (15%), Nereidae (15%) and Nephtys hombergii (11%). Total food consumption of the plaice population, excluding year class 1981, in 1980 and 1981 was estimated at 1.68 g and 1.41 g ash-free dry weight (ADW)/sq m/a. Annual consumption of O-group 1981 plaice was assessed at about 0.06 g ADW. The corresponding consumption of the flounder population was 1.14 g and 0.44 ADW, respectively. (Baker-IVI)
W86-01577

CARBON MINERALIZATION IN THE WATER OF LAKE GREVELINGEN (THE NETHERLANDS), AS MEASURED WITH THE OXYGEN CONSUMPTION METHOD,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. Goossens, R. S. Minnaar, and H. Verplanke.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 480-491, December, 1984. 4 Fig, 2 Tab, 37 Ref.

Descriptors: *Carbon, *Mineralization, *Lake Grevelingen, *Netherlands, Lakes, Oxygen consumption, Oxygen levels, Solar radiation.

The carbon mineralization rate in the water of Lake Grevelingen (Netherlands) was estimated by measuring the Oxygen Consumption Rate (OCR) of water samples from August 1980 until August 1981. Carbon respiration amounted to 305 g C/sq m/a. The water temperatures and the numbers of bacteria were also measured. Rapid and substantial changes in the oxygen consumption rate were observed. Regression analysis of OCR with a set of environmental parameters showed a particular high correlation of OCR with the summation of solar irradiance during 5 days preceding the day of sampling. Path analysis showed that the influence of solar irradiance on OCR was not primarily a temperature effect. The observed discrepancy between the estimate for the amount of carbon produced and mineralized in the water layer of the lake is discussed. (Baker-IVI)
W86-01578

MINERALIZATION OF ORGANIC CARBON ON AND IN THE SEDIMENT OF LAKE GREVELINGEN,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. J. Lindeboom, H. A. J. De Klerk, and A. J. J. Sandee.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 492-510, 1984. 4 Fig, 3 Tab, 43 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Mineralization, *Organic carbon, *Lake sediments, Saline lakes, Aquatic plants, Aquatic animals, Biomass, Diffusion, Bioturbation, Dissolved oxygen, Temperature.

Sediments play an important role in the biological activity in shallow aquatic environments. They function as major sinks or sources of inorganic and organic substrates for both primary production and mineralization in the water column and in the sediment. A study was made of mineralization on and in the sediments as a part of a research project on the carbon cycle in saline Lake Grevelingen (Netherlands). The oxygen uptake was measured using the bell jar method at 6 sampling stations. Applying a C over O2 conversion factor of 0.29, it was calculated that 330 g/sq m is mineralized in the sediment of the lake annually. Based on biomass estimates of the macroflora and fauna inside the bell jars and a regression analysis, the contribution of these organisms to the carbon mineralization rate was calculated to 70 and 95 g/sq m/a, respectively. The effect of oxygen gradients and apparent diffusion coefficients upon the oxygen uptake rate was studied with microelectrodes. This indicated that bioturbation is a major factor influencing the oxygen uptake rate. A good correlation was found between this rate and temperature. (Moore-IVI)
W86-01579

CARBON BALANCE OF A SALINE LAKE (LAKE GREVELINGEN, THE NETHERLANDS),
Waterloopkundig Lab. te Delft (Netherlands).
I. De Vries.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 511-528, 1984. 1 Fig, 4 Tab, 35 Ref.

Descriptors: *Carbon balance, *Saline lakes, *Lake Grevelingen, *Netherlands, Lakes, Carbon, Model studies, Ecosystems, Phytoplankton, Aquatic animals, Primary productivity, Food chains.

Lake Grevelingen is a former estuary in the Netherlands which was isolated by enclosing dams for the influences of the rivers Rhine and Meuse since 1964 and from the influence of the North Sea since

1971. The connection with the North Sea was partly reestablished in 1978. An annual gross carbon balance is presented for Lake Greveningen. Planktonic primary production is the main source of organic material, with an estimated contribution of at least 60%. From a comparison of the carbon balance with oxygen consumption measurements, the efficiency of the planktonic auto- and microheterotrophic community in producing particulate organic material is estimated at 44%. This is a high value compared to efficiencies of deeper coastal waters in the western English Channel and off the Belgian coast (2.34%). The pelagic and benthic compartment of the lake are tightly coupled by the filtering activity of benthic macrofauna, causing a high grazing pressure on phytoplankton (estimated at 55% of net production) and a transport of suspended organic particles to the sediment by deposition of feces and pseudofeces, exceeding passive sinking with a factor 3 to 4. In agreement with new data on the western Wadden Sea, the role of the benthic small foodweb in consuming primary organic matter is probably limited. (Baker-IVI)
W86-01580

SURVIVAL STRATEGIES OF INVERTEBRATES IN DISTURBED AQUATIC HABITATS,
Toronto Univ. (Ontario). Dept. of Zoology.
R. J. Mackay.
Journal of the Minnesota Academy of Science, Vol. 50, No. 3, p 28-30. 10 Ref.

Descriptors: *Invertebrates, *Benthos, *Aquatic habitats, Ecology, Ecological effects, Drought, Aquatic environment, Life cycles, Particulates, Water pollution effects.

Aquatic invertebrates face two main types of disturbances to their habitat: One is a change in the amount of water surrounding them as in a flood or drought; the other is a change in the physical or chemical quality of the water such as unusual or unnatural introductions of particulate or dissolved substances from the surrounding land. Aquatic invertebrates survive disturbance by moving to a refuge or alternative habitat or by having resistant or specially protected stages in the life cycle. Some invertebrates are able to exploit the richer and more available food materials that may result from disturbance. Sometimes the potential for regeneration or recolonization is so high that the loss of individuals is counteracted by the influx of colonizers from unaffected neighboring habitats. Most species in disturbed aquatic habitats are efficient colonizers; they combine one or more survival strategies with high powers of dispersal, rapid growth rates, and characteristics of ecological generalists. Some ecological generalists may even be somewhat flexible in their life cycles and be able to produce young at several times in the year. This characteristic is not seen in all invertebrates in snow-melt pools where the life cycles in some species must be precisely timed if the appropriate stage is to coincide with drought. But even in these pools, some generalists can rapidly take advantage of an early flood or a late drought. Given these characteristics of efficient colonizers, it is not surprising that the earliest newcomers after disturbance in aquatic habitats are insects. Their great powers of dispersal, regeneration, and tolerance make them remarkably resilient in the face of any kind of disaster, whether natural or deliberate. (Collier-IVI)
W86-01581

ESTIMATING THE POPULATION DYNAMICS OF COHO SALMON (ONCORHYNCHUS KISUTCH) USING POOLED TIME-SERIES AND CROSS-SECTIONAL DATA,
Rhode Island Univ., Kingston. Dept. of Resource Economics.
J. L. Anderson, and J. E. Wilen.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 459-467, March, 1985. 6 Tab, 16 Ref.

Descriptors: *Population dynamics, *Salmon, *Statistical analysis, *Washington, *Oregon, *California, *Columbia River, Fish management, Fish populations, Populations, Model studies.

The population dynamics of natural and hatchery coho salmon (Oncorhynchus kisutch) were estimated for three regions, (1) Washington coastal, (2) Columbia River region, and (3) Oregon/California coastal, using pooled time-series and cross-sectional data. Two functional forms were compacted: the Beverton-Holt and Ricker models. Both models yielded very similar results. In both cases, we found that the natural coho stock recruitment is significantly affected by parent stock level (positive), parent stock density (negative), river flow (positive), and hatchery smolt release (negative). The significant factors affecting hatchery coho salmon were smolt release level (positive), smolt release density (negative), and upwelling (positive). (Author's abstract)
W86-01585

WATER CIRCULATION IN SMALL ARCTIC LAKES IN WINTER,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
H. E. Welch, and M. A. Bergmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 506-520, March, 1985. 13 Fig, 12 Ref.

Descriptors: *Water circulation, *Arctic zone, *Lakes, *Winter, *Saqvaqjuac, *Northwest Territories, Mixing, Salinity, Stratification, Seasonal variation, Thermodynamics.

Dye experiments and detailed measurements of conductance and temperature in small lakes at Saqvaqjuac (63 degrees 39' N, 90 degrees 39' W, Northwest Territories) showed how water circulated in midwater. Stored heat returning from the sediments warms adjacent water, which then sinks downslope. Water immediately beneath the ice moves laterally shoreward, picking up cryoconcentrated salts and sinking downslope. Displacement of deep waters upward at the lake center is postulated as completing the circulation. Rates of water movement are on the order of 10 m/d in 2- to 10-ha lakes. This type of winter circulation is expected to be ubiquitous throughout the arctic. (Author's abstract)
W86-01586

WINTER RESPIRATION OF LAKES AT SAQVAQJUAC, N.W.T.,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
H. E. Welch, and M. A. Bergman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 521-528, March, 1985. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Northwest Territories, *Saqvaqjuac, *Lakes, *Respiration, *Winter, Arctic zone, Plankton, Carbon radioisotopes, Methane, Water pollution effects.

Winter oxygen consumption rates at 64 degrees N latitude were measured for 11 lake years. They ranged from 0.131 to 0.306 g O2/sq m/d. They were not correlated with lake depth, in contrast with the winter respiration rates of temperate lakes. We suggest that this difference results from lower summer temperatures and a lower proportion of planktonic respiration in arctic as compared with temperature lakes. C-14 estimates of annual photosynthesis were generally lower than estimated annual respiration, and the C-14-measured photosynthesis beneath the ice in winter was generally too low to account for the actual amounts of oxygen evolved by photosynthesis. In one lake a 50% increase in annual production resulted in an increase of only 19% in winter respiration, suggesting that lake respiration is an integrative process that averages out production over a period of years. Addition of methane gas to simulate a gas pipeline break to a lake resulted in an immediate 67% increase in lake respiration rate. (Author's abstract)
W86-01587

WATER TEMPERATURE AS THE PRIMARY INFLUENCE ON TIMING OF SEAWARD MIGRATIONS OF ATLANTIC SALMON (SALMO SALAR) SMOLTS,
Direktoratet for Vilt og Ferskvannsfisk, Sandnes (Norway). Forskningsstasjion for Ferskvannsfisk.
B. Jonsson, and J. Ruud-Hansen.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 593-595, March, 1985. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Water temperature, *Salmon, *Fish migration, *Norway, *Imsa River, *Smolts, Lunar cycle, Water flow, Rivers, Migration, Animal behavior.

Using multiple regression models the correlation of water temperature, water flow, cloudiness, and lunar cycle with the timing of the yearly descent of Atlantic salmon (Salmo salar) smolts in the Norwegian Imsa River, 1976-83 was tested. Water temperature between 9 April and 16 May explained 91, 95, and 89% of the yearly variation in date of 25, 50, and 75% cumulative smolt descent, respectively. The regression models were not very sensitive to variations of which date recording of the temperature was started and stopped. The start of the yearly smolt run was not triggered by a specific water temperature or a specific number of degree-days, but was controlled by a combination of temperature increase and temperature level in the river during spring. There was no significant correlation between smolt descent and any of the other environmental variables tested. (Author's abstract)
W86-01589

METHOD FOR MEASURING HORIZONTAL TRANSPORT OF ORGANIC CARBON OVER SEDIMENTS,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
J. Grant.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 595-602, March, 1985. 3 Fig, 24 Ref.

Descriptors: *Organic carbon, *Sediments, *Nutrient transport, Sand, Beaches, Benthos, Deposition.

Prewashed, precombusted sand from a sheltered beach in Nova Scotia was returned to the beach at low tide in metal pans. Hourly sampling of pans during high tide was used to assess gross deposition of organic carbon to the bed, with sampling at successive low tides to derive net deposition rate. Resuspension was considered to be the difference between gross and net deposition. Short-term burial of carbon was measured by vertically sectioning pan samples. The results indicate that due to resuspension, the rate of net deposition over 2d (11 g C/sq m/h) was only 42% of the rate of gross deposition that occurred during a single high tide. The method is useful because it can resolve the short-term particle fluxes that may be trophically important to benthic communities. (Author's abstract)
W86-01590

RESULTS OF OHIO RIVER MACROINVERTEBRATE SAMPLING FOR 1975-1981,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 5C.
W86-01591

SURVEY OF THE FRESHWATER MUSSEL FAUNA OF THE KANAWHA RIVER SEPTEMBER 1981-SEPTEMBER 1982,
West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. E. Schmidt, and M. A. Zeto.
Proceedings of the West Virginia Academy of Sciences, Vol. 55, No. 2/3/4, p 72-75, 1983. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Mussels, *Kanawha River, *West Virginia, Species composition, Aquatic population, Rivers, Benthos.

Freshwater mussels (naiads) were collected from the Kanawha River, West Virginia, at several locations between Winfield and Falls View as part of a statewide survey to identify naiad populations.

Sampling took place during the Fall of 1981 and the Fall of 1982 when the river was low and clear. Naiad populations were sampled with a 10-foot dovetail mussel brail and sight/hand collecting. Nineteen species of naiads and the asiatic clam Corbicula sp. were collected. The majority (18 species) were collected in the seven-mile stretch of the Kanawha River downstream of Kanawha Falls. Two species - Cyprogenia stegaria and Obliquaria reflexa are very rare in West Virginia. Only Corbicula sp. and one naiad species, Anodonta g. grandis, were collected downstream of Charleston. No endangered species were collected, although a population of Lampsilis abrupta (= orbiculata) is known to occur downstream of Kanawha Falls near Deepwater. (Author's abstract)
W86-01592

AQUATIC VEGETATION OF A NATURAL MARL LAKE IN WEST VIRGINIA,
West Virginia Univ., Morgantown. Dept. of Anatomy.
R. Bartgis.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 92-101, 1983. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Aquatic vegetation, *Marl lakes, *West Virginia, *Lake Louise, *Jefferson County, Mosses, Pondweed, Elodea, Duckweed, Species composition.

Lake Louise is a 14.5 m deep natural marl lake in Jefferson County, West Virginia. The aquatic vegetation of the lake occurs primarily in four concentric zones associated with increasing water depth. Each zone is characterized by a distinct plant community. In July 1982 the percent cover of each vascular and bryophytic species was recorded for each community. Dominant macrophytic species in these communities included the emergents Sparganium eurycarpum, and Nasturtium officinale and Veronica anagallis-aquatica in the two shallowest zones, respectively; Potamogeton spp. in an intermediate zone; and Elodea canadensis in the deepest zone. In addition, a fifth separate community dominated by Potamogeton crispus has developed in a small cove of the Lake. Within a community, vertical stratification also occurred. For example, the floating thalloid Lemna minor often formed a prominent surface layer. The flora of Lake Louise is similar to that of marl lakes in the glaciated northeastern United States. Community structure, such as species richness and number of dominants, was generally less complex at Lake Louise than in the northern lakes. (Author's abstract)
W86-01594

LIFE HISTORY AND ECOLOGY OF THE ALDERFLY, SIALIS AEQUALIS BANKS, FROM FLATFOOT CREEK, MASON COUNTY, WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Charleston.
R. W. Gatewod, and D. C. Tarter.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 102-113, 1983. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Flatfoot Creek, *Mason County, *West Virginia, *Alderflies, *Ecology, Hydrogen ion concentration, Water quality, Larvae, Growth stages.

The alderfly Sialis aequalis Banks, from Flatfoot Creek, Mason County, West Virginia, was studied relative to its life history and ecology between April 1978 and May 1979, and its low pH tolerance experimentally estimated in the laboratory. Larvae were collected along the stream margins from a substrate of vegetative debris, mud, and silt. Larvae were detritivorous in their feeding habits, despite the high food potential of their habitat. Their diet was infrequently supplemented with chironomids and other dipterans. Length frequency distributions for larvae indicated one size class for the population, and thus a univoltine life cycle. Growth rate, based upon mean head capsule width, was optimal during the first month of the larval stage (May-June). No increase in head capsule width was observed in February and March, the final months of the larval stage. Pupation in the laboratory was variable in duration, ranging from 10 to 22 days. In the field, pupation began in late March and concluded 4 to 5 weeks later. Adults were first observed in late April, and none were sighted after May 10. Ovarian eggs of adult females ranged in number from 402 to 818, -x = 657. Mean egg length and width were 0.23 and 0.61 mm, respectively. The 96-hour median tolerance limit for low pH for S. aequalis larvae was 2.3. W86-01595

RESERVOIR FISHERY RESEARCH NEEDS AND PRIORITIES,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 8I.
W86-01598

ASSESSING HABITATS USED BY WARMWATER STREAM FISHES,
Illinois Natural History Survey, Champaign.
R. W. Larimore, and D. D. Garrels.
Fisheries, Vol. 10, No. 2, p 10-16, March/April, 1985. 8 Fig, 2 Tab, 10 Ref.

Descriptors: *Aquatic habitats, *Fish populations, *Streams, Habitats, Monitoring, Radiotelemetry, Animal behavior, Ecology, Fish behavior.

Five methods were developed for locating and identifying an undisturbed, free-swimming, stream fish. These methods used (1) color-coded tags, (2) fixed electrodes, (3) optical measurements, (4) night collections, and (5) radiotelemetry. They permitted observations of most kinds of fishes, at any time of day or night, during any season (including under ice), and from streams of different sizes. Although no one method was equally useful in all situations, the methods were evaluated according to their effectiveness in determining habitat preferences of different fish species under various stream conditions. The importance of precision in locating a fish and its habitat was emphasized by the finding of significant differences in physical measurements over extremely small areas. (Author's abstract)
W86-01599

MANAGEMENT OF LACUSTRINE FISHERIES IN THE TROPICS,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
For primary bibliographic entry see Field 8I.
W86-01600

EFFECT OF TEMPERATURE ON THE GROWTH OF PLANKTONIC LARVAE OF TELLINA TENUIS DA COSTA,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5C.
W86-01603

CALCIUM CHEMISTRY AND DEPOSITION IN IONICALLY ENRICHED ONONDAGA LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W86-01618

GROWTH OF SUBMERSED MACROPHYTE COMMUNITIES IN THE ST. CLAIR - DETROIT RIVER SYSTEM BETWEEN LAKE HURON AND LAKE ERIE,
Fish and Wildlife Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. W. Schloesser, T. A. Edsall, and B. A. Manny.
Canadian Journal of Botany, Vol. 63, No. 6, p 1061-1065, June, 1985. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Macrophytes, *Plant growth, *Aquatic plants, *St. Clair River, *Detroit River, Submerged plants, Biomass, Seasonal variation, Rivers, Overwintering, Dominance, Succession, Great Lakes.

Growth of submersed aquatic macrophytes was determined from observation and on the basis of biomass of samples collected from April to November 1978 at seven study sites in a major river system of the Great Lakes, the St. Clair - Detroit river system between Lake Huron and Lake Erie. Growth usually began between April and June, peaked between July and October, and decreased by late November. Maximum biomass at six of the seven sites (118-427 g dry weight/sq m) was similar or greater than that reported in other rivers at similar latitudes. Seasonal growth of the abundant taxa followed one of three seasonal patterns at each study site: one dominant taxon grew alone; codominant taxa grew sympatrically without species succession; and codominant taxa grew sympatrically with species succession. Differences in growth and seasonal succession of some taxa were apparently caused by the presence of absence of overwintering plant material, competition, and life-cycle differences. (Author's abstract)
W86-01629

SIMPLE METHOD TO ESTIMATE LAKE PHOSPHORUS CONCENTRATIONS RESULTING FROM NATURAL, BACKGROUND, LOADINGS,
Pavia Univ. (Italy). Ist. di Entomologia Agraria.
M. Vighi, and G. Chiaudani.
Water Research, Vol. 19, No. 8, p 987-991, 1985. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Phosphorus, *Lakes, *Morphoedaphic index, Water depth, Alkalinity, Conductivity, Water quality control, Lake restoration, Eutrophication, Trophic levels.

The relation of mean total phosphorus concentrations to morphoedaphic index (calculated as the ratio between the mean depth and alkalinity or the conductivity) has been examined for a large, diverse, widely distributed group of lakes. A highly significant correlation was found in lakes practically not affected by anthropogenic input of phosphorus. As a consequence the phosphorus concentration in a lake resulting from natural, background loading could be calculated on the basis of the morphoedaphic index. The evaluation of natural phosphorus concentration allows the prediction of the maximum extent to which actual phosphorus concentrations could be reduced in culturally eutrophied lakes by eliminating the anthropogenic inputs and to calculate 'permissible' loadings necessary to achieve natural trophic conditions that will not necessarily correspond to oligotrophy. (Author's abstract)
W86-01640

DIAGENETIC REMOBILIZATION OF MANGANESE, IRON, COPPER AND LEAD IN ANOXIC SEDIMENT OF A FRESHWATER POND,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
M. Sakata.
Water Research, Vol. 19, No. 8, p 1033-1038, 1985. 3 Fig, 27 Ref.

Descriptors: *Manganese, *Iron, *Copper, *Lead, *Sediments, Ponds, Reservoirs, Interstitial water, Anoxic conditions, Remobilization, Fate of pollutants, Heavy metals.

The diagenetic remobilization of manganese, iron, copper and lead in anoxic sediment of a freshwater pond, T Reservoir, Japan has been examined in an in situ submerged chamber system, through interstitial water and sediment analyses. Manganese was released continuously from the sediment into the overlying water during the experiment, whereas iron was released from the sediment abruptly after the 2nd day of the experiment. Steep vertical concentration gradients of manganese and iron were observed in the interstitial water. The release of manganese and iron from the sediment is due to the dissolution of ferro-manganese oxides and hydroxides in the surface sediment under anoxic condition. In contrast to manganese and iron, copper and lead were not released from the sediment during the experiment, and their concentrations in the interstitial water were not significantly different from the values of the overlying water. The

results show that the diagenetic remobilization of copper and lead in the sediment is negligibly small. It is likely that copper and lead are fixed into the sediment by some process other than the formation of sulfides. (Author's abstract)
W86-01646

GEOCHEMICAL MASS BALANCE OF A VOLCANIC CRATER LAKE IN AUSTRALIA,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
L. M. Ramamurthy, H. H. Veeh, and J. W. Holmes.
Journal of Hydrology, Vol. 79, No. 1/2, p 127-139, July, 1985. 5 Fig, 6 Tab, 12 Ref.

Descriptors: *Blue Lake, *South Australia, *Crater lakes, *Chemical composition, *Geochemistry, Groundwater, Uranium, Calcium, Sodium, Chlorides, Nitrates, Water quality control, Conjunctive use, Lakes.

Blue Lake in the southeast of South Australia is the largest of a group of four volcanic crater lakes in the regions. It has a surface area of approximately 600,000 sq m, an average depth of 70 m, and is the main source of reticulated water supply to a city with a population of about 20,000 inhabitants. Nitrate concentrations have been rising steadily over the years. The recharge regime of Blue Lake was determined by using the environmental tracers U and Ca (partly precipitated in the sediments) and Na and Cl (conserved in the lake's waters). The geochemical mass balances allowed best estimates of the water budget to be derived. These are: inflow rate from groundwater of 5,000,000 cu m/yr; the outflow rate into the groundwater is therefore about 1,000,000 cu m/yr, because the measured pumping rate is 4,000,000 cu m/yr. The unconfined, Gambier limestone aquifer contributes 85% to the inflow and receives 100% of the outflow. The lower-lying aquifer (Dilwyn Formation fluviatile sediments) contributes 15% to the inflow. Since the unconfined aquifer is the main source of recharge to the lake, the problem of increasing nitrate concentrations of the lake water could be ameliorated by initiating conservation measures to restrict further pollution of the water table aquifer. The confined aquifer in the region could be exploited further to supplement the drinking water requirements of the region, since the composition of Blue Lake itself would not be adversely affected as a consequence. (Moore-IVI)
W86-01663

METHOD FOR LOCATING SEDIMENT ANOMALIES IN LAKEBEDS THAT CAN BE CAUSED BY GROUNDWATER FLOW,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
D. R. Lee.
Journal of Hydrology, Vol. 79. No. 1/2, p 187-193, July, 1985. 3 Fig, 13 Ref.

Descriptors: *Groundwater movement, *Measuring instruments, *Lake beds, Temperature, Conductivity, Seepage, Lake sediments, Groundwater inflow.

Underwater discharges of groundwater should be characterized not only by anomalous temperature distributions but also by water interface of lakes. Location of inflows by detecting such anomalies may be effective where groundwater inflow areas can be inferred from other geologic or hydraulic information, such as areas of lakes that lie over fracture or fault zones. A device was designed to be dragged along lakebeds for locating such anomalies in sediment temperature or chemistry. The drag was a density balanced probe containing temperature transducers and an electrical conductivity cell. The drag was used successfully to detect an artificially created seepage area in soft bottom sediment below 8 m of lake water. The drag has been designed for in-situ, continuous, horizontal profiles of the absolute temperature of sediment, the temperature difference between sediment and overlying water, and the electrical conductivity of sediment. (Baker-IVI)
W86-01667

ESTIMATING ALGAL AVAILABLE PHOSPHORUS IN SUSPENDED SEDIMENTS BY CHEMICAL EXTRACTION,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W86-01714

SIMULTANEOUS IN-STREAM NITROGEN AND D.O. BALANCING,
Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
J. J. Warwick, and A. J. McDonnell.
Journal of Environmental Engineering, Vol. 111, No. 4, p 401-416, August, 1985. 3 Fig, 4 Tab, 39 Ref.

Descriptors: *Nitrogen, *Dissolved oxygen, *Water analysis, *Model studies, Nutrients, Water quality, Ammonia, Nitrates, Nitrites.

A one-dimensional, pseudo unsteady state, water quality model (Simultaneous Nitrogen and Oxygen Analysis Program - SNOAP) was developed to simultaneously solve both nitrogen and dissolved oxygen mass balance equations. Expressions are derived to estimate ammonia-N exsolution, bacterial ammonia-N uptake, and aquatic plant ammonia-N assimilation in terms of standard water quality indices. The SNOAP model calculates hourly values for all nitrogen species reaction rates (including nitrification and denitrification) based on observed in-stream variation of organic-N, ammonia-N, nitrite-N, nitrate-N, dissolved oxygen, temperature, and pH. An iterative solution algorithm is required to simultaneously solve the nitrogen and dissolved oxygen mass balance equations. This iterative approach is stable and results in relatively quick convergence. Erroneous values of observed nitrogen species or dissolved oxygen variation, or both, may result in an impossible situation for simultaneous nitrogen and dissolved oxygen mass balance solution. This nonconvergence feature is a significant attribute, in that is allows for a systematic screening of measured water quality data. (Author's abstract)
W86-01722

NITROGEN ACCOUNTABILITY FOR FERTILE STREAMS,
Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
J. J. Warwick, and A. J. McDonnell.
Journal of Environmental Engineering, Vol. 111, No. 4, p 417-430, August, 1985. 6 Fig, 7 Tab, 12 Ref.

Descriptors: *Nitrogen, *Streams, *Dissolved oxygen, *Water quality, *Model studies, Denitrification, Ammonia, Water pollution effects, Wastewater.

The Stream Nitrogen and Oxygen Analysis Program (SNOAP) is a one-dimensional, pseudo unsteady state, water quality model, which simultaneously solves both nitrogen and dissolved oxygen mass balance equations. The SNOAP model was successfully calibrated and verified for three, independent, data intensive water quality surveys. The modeled stream system was unsteady due to significant upstream impact from wastewater treatment plant effluent discharges. Denitrification was found to be the dominant total nitrogen sink. Average denitrification rates calculated by the SNOAP model range from 22.0-43.6 mg-N/sq m/hr. The computed values compared quite favorably with measured laboratory sediment denitrification rates which ranged from 28.2-39.2 mg-N/sq m/hr. In addition, the rate of ammonia-N decay was found to be the most accurate nitrogen species estimator of in-stream nitrification rates. (Author's abstract)
W86-01723

ATTENUATION VERSUS TRANSPARENCY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5A.
W86-01725

SUMMER SOIL MOISTURE CONTENT AND THE WATER TABLE IN A FORESTED WETLAND PEAT,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2G.
W86-01779

TRITIUM IN NATURAL WATERS OF MOLDAVIA AND A HYDROGEOLOGICAL INTERPRETATION OF THE RESULTS OF ITS DETERMINATION,
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
I. V. Zelenin, I. E. Verbitskii, I. K. Morkovkina, and V. V. Romanov.
Water Resources, Vol. 11, No. 1, p 324-334, July-August, 1984. 3 Fig, 4 Tab, 17 Ref. Translated from Vodnye Resursy, No. 4, p 70-81, July-August, 1984.

Descriptors: *Tritium, *Natural waters, *Moldavia, *Dnestr River, *Prut River, *USSR, River water, Precipitation, Groundwater, Water analysis, Groundwater movement, Aquifers.

The main hydrographic elements of Moldavia (USSR) are the Dnestr and Prut rivers. They originate in the Carpathians and have mean annual discharges respectively of 293 and 74 cu m/sec. The main aquifer complex is represented mainly by limestones of Baden-Sarmatina age. Its thickness reaches 100-150 m. The character of groundwater movement is quite complex due to the variability of the conditions of their recharge and discharge, inhomogeneity of the seepage properties of the rocks, intense water withdrawal from wells, and also by the absence in the geological section of thick, persistant impervious horizons which could serve as regional aquicludes. The groundwaters in the cover deposits of divides are partially directed toward the thalwegs of the erosional incisions, where they merge with the waters of the floodplain alluvium, and partially percolate into lower lying aquifers. In 1978-80 the tritium concentrations in river waters varied mainly from 40 to 90 TU. Neither regional nor temporal trends were noted in this case. The observed variations, in particular, are related to the nonuniformity of tritium concentrations in precipitation. Especially noticeable is the relation between tritium concentrations in river water and precipitation for the Dnestr River, where the effect of regulation of surface runoff is apparently not felt so strongly as in small rivers. In the overwhelming majority of cases the tritium concentrations in rivers are less than in precipitation, by about 30% on average in small rivers. This indicates a considerable role of the groundwater component in feeding rivers and agrees well with the hydrological estimate of the portion of groundwaters (23-27%) in the river runoff of the Dnestr-Prut interfluve. (Baker-IVI)
W86-01806

INVESTIGATION OF CO2 GAS EXCHANGE IN A CONVECTIVELY MIXED LAYER,
Moscow State Univ. (USSR).
A. O. Kokorin.
Water Resources, Vol. 11, No. 4, p 343-347, July-August, 1984. 1 Fig, 11 Ref. Translated from Vodnye Resursy, No. 4, p 90-94, July-August, 1984.

Descriptors: *Carbon dioxide, *Convection, *Gas exchange, Temperature effects, Stratification, Model studies, Oxygen transport, Mixing.

The conditions of fall-winter cooling accompanied by convective mixing of the upper layer of the water body and gradual deepening of the boundary of the convectively mixed layer are examined. The experimental profiles obtained made it possible to calculate the flow of carbon dioxide from water into the air and the average gas exchange rate k. The flow and gas exchange rate were calculated for 10 experimental series, each of which consisted of a period of heating of the basin from above (2-4 days) and period of cooling accompanied by convective mixing (6-9 hr). The CO2 distribution with respect to depth is determined by processes of diffusion and gas exchange across the interface and also by the chemical equilibrium between various carbonate forms. The concentration gradients of various carbonate forms are not equal among

themselves and therefore independent diffusion can lead to a redistribution of the total concentration of inorganic carbon between carbonate forms. A model is proposed which proved able to satisfactorily describe the experimental data. The formula used in the model for calculating the exchange coefficient during convective mixing gave values of the coefficient close to those found in natural water bodies, and it is assumed that the given calculation scheme will work satisfactorily also in the case of gas transport during fall-winter cooling of the ocean. In a simplified form the model was tested for calculation of oxygen transport. (Baker-IVI)
W86-01808

PHOSPHORUS FORMS AND CONTENT IN NATURAL WATER AND FACTORS DETERMINING ITS CYCLING,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2K.
W86-01811

HYDROLOGICAL AND HYDROCHEMICAL ASPECTS OF THE TRANSFORMATION OF ORGANIC MATTER IN THE MOZHAISK RESERVOIR,
Moscow State Univ. (USSR).
L. B. Berdavtseva, and G. V. Tsytsarin.
Water Resources, Vol. 11, No. 4, p 370-377, July-August, 1984. 4 Fig, 3 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 121-129, July-August, 1984.

Descriptors: *Organic matter, *Mozhaisk Reservoir, *Hydrology, Chemical analysis, Phosphorus, Dissolved oxygen.

An analysis of the transformation of organic matter in the Mozhaisk reservoir on the basis of the indices of color, permanganate oxidizability (PO), and dichromate oxidizability (DO) in the annual cycle showed the main cause of the most considerable changes in the relationship between the investigated indices is occurrence of labile organic matter (LOM) related to intensification of production-destruction processes. All changes in the relationships between the investigated indices occur synchronously. The character of the relation between color, PO and DO changes practically simultaneously in response to an increase of the amount of LOM in the reservoir, which makes it possible to estimate the direction of processes forming the water quality at each given moment on the basis of one of the relationships or both simultaneously. Two extreme types of dependence, expressed by the equation of linear regression between the investigated indices, which conditionally characterize the maximum degree of transformation and maximum degree of instability of OM were distinguished. (Baker-IVI)
W86-01812

SPACE-TIME INHOMOGENEITY OF DISTRIBUTION OF ORGANIC MATTER IN THE MOZHAISK RESERVOIR,
Moscow State Univ. (USSR).
M. G. Ershova, M. B. Zaslavskaya, and N. M. Zyablova.
Water Resources, Vol. 11, No. 4, p 378-385, July-August, 1984. 4 Fig, 7 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 130-138, July-August, 1984.

Descriptors: *Mozhaisk Reservoir, *USSR, *Organic matter, Reservoirs, Chemical composition, Seasonal variation, Temporal distribution.

Within an accuracy of 25%, the study showed the effect of production-destruction processes on the average organic matter concentrations in individual sufficiently large stretches and in the entire volume of the Mozhaisk reservoir (USSR) is insignificant and it can be neglected in such calculations. It is possible that this conclusion is applicable also to other more eutrophic reservoirs of the forest zone with seasonal streamflow regulation. The characteristic weather changes for this zone during the growing season result in the times of dominance of the production of organic matter are replaced by times of dominance of destruction of autochthonous organic matter and on the whole the average concentration of organic matter is to a considerable extent determined by the amount of allochthonous matter introduced from the drainage basin. (Baker-IVI)
W86-01813

FORMATION OF THE HYDROBIOLOGICAL AND HYDROCHEMICAL REGIME OF THE NORTHERN DONETS-DONBAS CANAL (1958-1981),
Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).
A. I. Kovrizhnykh.
Water Resources, Vol. 11, No. 4, p 391-396, July-August, 1984. 2 Ref. Translated from Vodnye Resursy, No. 4, p 144-150, July-August, 1984.

Descriptors: *Northern Donets-Donbas Canal, *USSR, *Bottom sediments, Canals, Erosion, Siltation, Phytoplankton, Velocity, Transparency, Bottom sediments.

The Northern Donets-Donbas Canal (USSR) has been operating for more than 20 years. During this period, the main characteristics of the hydrobiological and hydrochemical regimes of the canal at different stages of its operation have been established. Substantial changes were noted in the hydrobiological regime of the canal. Impoverishment of the species composition of phytoplankton occurred due to the elimination of green algae and the abundance of blue-greens decreased. In the phytobenthos the quantity of green filmentous algae decreased considerably and the mass development of Vaucheria and appearance of Thorea occurred. The abundance of submersed higher aquatic plants decreased and a tendency toward an expansion of the areas occupied by amphiphytes was noted. Among the main interdependent factors that caused these changes are an increase of flow velocities, decrease of water transparency, siltation, and erosion and redistribution of bottom sediments in the canal. (Baker-IVI)
W86-01815

CHARACTERISTICS OF FISH HELMINTH FAUNA IN SOME WATER BODIES OF THE NORTH DVINA BASIN UNDER CONDITIONS OF AN ALTERED WATER REGIME,
Gosudarstvennyi Nauchno-Issledovatel'skii Inst. Ozernogo i Rechnogo Rybnogo Khozyaistva, Leningrad (USSR).
E. A. Bogdanova, and L. I. Kotova.
Water Resources, Vol. 11, No. 4, p 396-401, July-August, 1984. 1 Tab, 29 Ref. Translated from Vodnye Resursy, No. 4, July-August, 1984.

Descriptors: *Dvina Basin, *USSR, *Biomass, *Helminths, *Fish parasites, Runoff, Seasonal variations, Shallow water, Lake Kubenskoe, Lake Lacha, Lake Vozhe, Parasites, Hydrological regime.

The region of Lakes Kubenskoe, Lacha, and Vozhe belongs to the excess moisture zone of the European sector of the USSR. Lake Kubenskoe is a large shallow water body with an area of 400 sq km, average depth of 2.5 m, and maximum depth of 4.5 m. The variation of individual elements of the climate is governed by the effect of certain types of atmospheric circulation. The annual distribution of the runoff of the rivers, creeks, and brooks emptying into Lake Kubenskoe mainly determines its level regime. All three lakes are intensely overgrown by macrophytes. In the winter the dissolved oxygen content in the water does not exceed 32% of saturation. During inflow of Sukhona waters into Lake Kubensoe an overall increase of biogenic substances in it is possible. Many fish parasites have favorable ecological conditions in the lake for development. Some reservoirs constructed on rivers possess their own hydrobiocenose, including invertebrates and fishes. Beds of macrophytes with an invertebrate fauna characteristic for them will appear in the littoral, well-heated stretches with a weak current. With time they will become the nesting sites of fish-eating birds, which will lead to increased infestation of fishes by cestodes and trematodes. The presently available ichthyoparasitologic data show that a number of helminths having epizootological and epidemiological significance are found in many fishes of Lake Kubenskoe and the Sukhona River. (Baker-IVI)
W86-01816

INVESTIGATIONS OF THE ECOLOGY OF PLANKTONIC ALGAE OF WATER BODIES IN THE BAIKAL REGION,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
O. M. Kozhova, and V. N. Pautova.
Water Resources, Vol. 11, No. 3, p 244-253, May-June, 1984. 2 Fig, 1 Tab, 20 Ref. Translated from Vodnye Resursy, No. 3, p 114-124, May-June, 1984.

Descriptors: *Algal growth, *Seasonal variation, *Phytoplankton, *Lake Baikal, *Angara Reservoir, *USSR, Ice cover, Spatial distribution, Ecology, Reservoirs, Lakes.

The characteristics of the ecology of algae was established during the analysis of their temporal dynamics. Seasonality in the development of phytoplankton of Lake Baikal and the Angara reservoirs is clearly expressed as a replacement of a cryophilic complex of algae developing in the ice-covered period by a more thermophilic summer complex. Such a succession of species is typical for all water bodies of temperate latitudes. The seasonality in the develoment of phytoplankton of Angara reservoirs is expressed differently than in Baikal. In Bratsk reservoir an under ice maximum development of algae is observed every year. In Baikal, productive years for under ice phytoplankton, when the biomass reaches 30 g/cu m and more, recur with a period of 2-4 years. In nonproductive years the under ice biomass of phytoplankton of Baikal does not exceed 0.1 g/cu m. In the Bratsk reservoir in connection with the short time of under ice development of phytoplankton, which is recorded only from the second half of April, before breakup of the reservoir, the bulk of the biomass is created in open water, whereas in Baikal, life in the lake depends on the algal biomass in the ice-covered period in a productive year not only in that year but in subsequent years. In Bratsk reservoir the same species form the under-ice maximum biomass of phytoplankton from year to year. In Baikal there are far more species under the ice. Similar studies were conducted regarding the spatial distribution of the algae as well. (Baker-IVI)
W86-01824

MICROBIOLOGICAL CHARACTERISTICS OF WATER MASSES IN THE MOUTH REGIONS OF LARGE RIVERS FLOWING INTO NORTHERN BAIKAL,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
V. N. Maksimov, E. A. Maksimova, and A. R. Rudykh.
Water Resources, Vol. 11, No. 3, p 253-268, May-June, 1984. 3 Fig, 9 Ref. Translated from Vodnye Resursy, No. 3, p 125-130, May-June, 1984.

Descriptors: *Rivers, *Lake Baikal, *USSR, *Microbiology, Vertical distribution, Bacteria, River mouth.

The mouth regions of large rivers of northern Baikal based on microbiological indices, are a complex system of mixing of two water masses, river and lake. Their inhomogeneity is clearly traced on the basis of the vertical dynamics of the production values and abundance of saprophytic bacteria. The water of northern Baikal, and especially the river mouth regions, is distinguished by increased (often by an order of magnitude) indices of microbiological activity compared with waters of central and southern Baikal. The microbiological indices in waters of the Tompa River and its mouth region should be considered natural (background) since, at present, the river is not experiencing direct anthropogenic influences. The lowest bacterial production is found in waters of the Kholodnaya and Rel' rivers (1.33 and 0.79 micro-g C/liter/

day). As a consequence of this their potential capacity for self-purification is quite low. Microorganisms capable of growing on media with hydrocarbons are constant components of microbiocenoses of the water column of northern Baikal. (Baker-IVI)
W86-01825

SHORE ZONE MAPPING AND CLASSIFICATION OF A NORTHERN LAKE,
Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
G. D. McKenzie, and D. I. McKenzie.
Shore and Beach, Vol. 52, No. 4, p 9-14, October, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Lake shores, *Mapping, *Ontario, *Kesagami Lake, Beaches, Classification, Geology, Peat, Shores.

A descriptive shore zone classification, consisting of ten classes was developed to understand the geology of Kesagami Wilderness Park, a new wilderness park in Ontario, during an earth science assessment of the region. The shore map depicts the types of shores in a descriptive classification and provides useful information for planners, managers, lake users and exploration geologists. The most unusual features of the shores of Kesagami Lake are the peat bluffs up to 4 m in height. They have been recognized for almost a century and remain exceptional for Ontario. They provide an interpretive and scientific resource in that they show the subsurface dimension of a landscape that is common for much of northern Ontario. Probably the most important information shown on the shore zone map of Kesagami lake is the number and location of the sand beaches which historically have been the landing and camping sites. The sand beaches are themselves unusual in that many overlie peat and may be as thin as 10 cm. The shores of another lake (Missinaibi Lake) have been mapped and classified in like fashion for similar purposes. It is believed that these techniques can be applied in a useful manner in lakes throughout the glaciated uplands. (Baker-IVI)
W86-01839

CHEMICAL COMPOSITION OF TRANSKEI RIVER WATER,
Durban-Westville Univ. (South Africa). Dept. of Chemistry.
A. Du Preez.
Water S. A., Vol. 11, No. 1, p 41- 47, January, 1985. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Transkei, *South Africa, *Chemical composition, *Rivers, Water quality, Molybdenum, Arsenic, Mercury, Water pollution sources, Urban areas, Silt.

The water quality of the rivers flowing through Transkei was determined over a period of two years to afford a general picture of the chemical composition of Transkei river water. The period of study coincided with a relatively dry period in Transkei (and Southern Africa) and all results will have to be evaluated within this context. The more important findings resulting from the study are: Transkei River water generally contains very few dissolved constituents; the south-western parts of Transkei exhibit higher concentrations of analytes compared to north-eastern Transkei; pollution within Transkei is limited to Butterworth (urban contamination; macro elements plus molybdenum) and a number of other sites where very high arsenic concentrations are attributed to the leaching of old cattle dip material into rivers; pollution in the Republic of South Africa adjoining Transkei is at Queenstown (urban contamination; macro elements) and in the Elliot-Ugie-Maclear region (mercury); and silt loads in terms of unit areas of catchment are lower than presently accepted norms. (Author's abstract)
W86-01862

MOLYBDENUM AVAILABILITY, NITROGEN LIMITATION, AND PHYTOPLANKTON GROWTH IN NATURAL WATERS,
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
R. W. Howarth, and J. J. Cole.
Science, Vol. 229, No. 4714, p 653-655, August, 1985. 1 Fig, 1 Tab, 38 Ref. NSF grants BSR-83-05176 and INT-83-04275.

Descriptors: *Limiting nutrients, *Molybdenum, *Phytoplankton, *Nitrogen, Marine environments, Coastal waters, Lakes, Algal growth, Sulfates, Phosphorus, Nitrogen fixation, Nitrates.

In most lakes, the supply of phosphorus controls primary productivity, yet phytoplankton productivity in most estuaries and coastal seas is controlled by nitrogen supply. Rates of nitrogen fixation may be low in coastal waters because molybdenum availability is low. In a series of experiments examining the uptake of radioactive Mo-99 by phytoplankton, environmentally realistic concentrations of sulfate inhibit molybdate assimilation. Sulfate inhibition of molybdate assimilation by phytoplankton makes molybdate less available in seawater than it is in freshwater. As a result, nitrogen fixation and nitrate assimilation, both processes that require molybdenum, may require a greater expenditure of energy in seawater than in freshwater. Experimentally increasing the ratio of sulfate to molybdate inhibits molybdate uptake, slows nitrogen fixation rates, and slows the growth of organisms that use nitrate as their nitrogen source. (Moore-IVI)
W86-01863

STUDY OF THE DISTRIBUTION OF FRESHWATER MUSSELS (MOLLUSCA: PELECYPODA: UNIONOIDA) OF THE LAKE CHAMPLAIN DRAINAGE IN NORTHWESTERN NEW ENGLAND,
Massachusetts Univ., Amherst. Museum of Zoology.
D. G. Smith.
American Midland Naturalist, Vol. 114, No. 1, p 19-29, July, 1985. 3 Fig, 3 Tab, 29 Ref.

Descriptors: *Lake Champlain, *Mussels, *Distribution, Fall line, Migration, Species composition, History.

Lake Champlain occupies a large shallow basin in northeastern North America and drains to the St. Lawrence River. The freshwater mussel fauna of the lake's drainage system includes both Northern Atlantic and Interior Basin species. An analysis of the distribution of the mussel species in the eastern and southern drainage streams of Lake Champlain reveals that fall lines have controlled upstream migration at various stages during the lake's postglacial history. Species composition differs above and below fall lines within drainage streams and varies geographically between drainage streams. Such distribution patterns may be explained by proposed periodic invasions of Lake Champlain by species during specific postglacial lake stages. (Author's abstract)
W86-01877

EFFECTS ON THE FOREST FLOOR OF WHOLE-TREE HARVESTING IN AN APPALACHIAN OAK FOREST,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Forestry.
J. E. Johnson, D. W. Smith, and J. A. Burger.
American Midland Naturalist, Vol. 114, No. 1, p 51-61, July, 1985. 2 Fig, 4 Tab, 40 Ref.

Descriptors: *Whole-tree harvesting, *Logging, *Oak trees, *Nutrients, Forest management, Soil solution, Clear-cutting, Soil temperature, Ammonia, Nitrates, Potassium, Soil water, Cycling nutrients.

The size of the forest floor nutrient pool and degree of mineralization from this pool (as measured by nutrient concentrations in the soil solution) were compared between a clear-cut and an adjacent forested site. Forest floor dry weights and nutrient contents were monitored for 28 months following the whole-tree harvest. Soil solution nutrient concentrations, temperature at a depth of 2.5 cm, and percent moisture in the top 10 cm of mineral soil were also monitored following cutting. Immediately following cutting, the forest floor was significantly heavier in the cut area due to logging residue, but after 28 months the clear-cut area forest floor had a dry weight of 10,500 kg/ha compared to 15,400 kg/ha in the uncut area. Following cutting, concentrations of NH4(+)-N, NO3(-)-N and K were higher in the soil solution of the cut area, whereas concentrations of P, Ca and Mg were similar in both areas. The higher concentrations in the clear-cut were attributed to more rapid decay of logging slash and forest floor material and reduced vegetative uptake. (Author's abstract)
W86-01878

POPULATION AND REPRODUCTIVE DYNAMICS OF NAIS COMMUNIS (OLIGOCHAETA: NAIDIDAE) FROM A WISCONSIN LIMNOCRENE,
Wisconsin Univ.-Milwaukee. Dept. of Zoology.
M. E. Smith.
American Midland Naturalist, Vol. 114, No. 1, p 152-158, July, 1985. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Limnocrenes, *Oligochaetes, *Population dynamics, *Reproduction, Wisconsin, Springs, Paratomy, Water temperature, Alkalinity, Hydrogen ion concentration, Biomass.

Population and reproductive dynamics of the oligochaete Nais communis were studied from August 1982 to November 1983 in a Wisconsin limnocrene (a spring discharging into a small basin which overflows into a stream channel). The study site was located in the township of Saukville, Ozaukee County. Naidids were found only among the large floating mats of Spirogyra which covered most of the limnocrene. Population density was significantly ($P < 0.05$) correlated with water temperature, total alkalinity and pH. Abundance peaks occurred during mid-August 1982 and early October 1983. No sexually mature worms were collected; asexual reproduction by paratomy took place throughout the study. Nais communis exhibited at most three zooids per chain; the majority of worms exhibited two zooids per chain when reproducing. There was no significant ($P > 0.05$) correlation of percentage of worms undergoing paratomy to environmental physico-chemical parameters and worm density. Mean doubling time for the field population of N. communis was 13.57 +/- 13.00 days. Seasonal changes in biomass were similar to those of abundance. (Moore-IVI)
W86-01879

SEASONAL CHANGES IN ABUNDANCE OF BROWN TROUT (SALMO TRUTTA) AND RAINBOW TROUT (S. GAIRDNERII) ASSESSED BY DRIFT DIVING IN THE RANGITIKEI RIVER, NEW ZEALAND,
Ministry of Agriculture and Fisheries, Wellington (New Zealand). Fisheries Research Div.
B. J. Hicks, and N. R. N. Watson.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 1-10, 1985. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Trout, *Seasonal variation, *Rangitikei River, *New Zealand, Drift diving, Fish, Abundance.

Numbers and approximate sizes of brown trout (Salmo trutta L.) and rainbow trout (S. gairdnerii Richardson) were estimated by snorkel divers at 6 sites in the middle reaches of the Rangitikei River, North Island, New Zealand, over 14 months. The results showed that different species and sizes of trout varied in abundance with time. The species of fingerling trout (6-12 cm FL) could not be identified because of their small size and shoaling behavior. Rainbow trout abundance varied seasonally and was greatest in January and April (between 18 and 60 fish per kilometer) when fish between 23 and 38 cm FL were the most abundant size class. Brown trout abundance showed much less variation with time (between 5 and 36 fish per kilometer at most sites). Also in contrast to rainbow trout, the majority of brown trout were > 38 cm FL, and in June, when the greatest density was observed (56 fish per kilometer), 70 redds were

seen at the same site. Two sites were dived within a 48 h period to test the variability of the method. Comparisons between the 3 dives at each site revealed no significant differences between the numbers of fish in different species and size classes. (Author's abstract)
W86-01910

NUTRIENT DEMAND AND AVAILABILITY AMONG PLANKTONIC COMMUNITIES - AN ATTEMPT TO ASSESS NUTRIENT LIMITATION TO PLANT GROWTH IN 12 CENTRAL VOLCANIC PLATEAU LAKES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
E. White, K. Law, G. Payne, and S. Pickmere.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 49-62, 1985. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Limiting nutrients, *Phytoplankton, *Lakes, *New Zealand, Nitrogen, Phosphorus, Algal growth, Bioassays, Nutrient storage.

Water from 12 central volcanic plateau lakes in New Zealand was studied on 4 occasions (one in each season). Four assays of nitrogen demand and 3 for phosphorus were employed in an attempt to identify the nutrients limiting plankton growth. Orthophosphate turnover times chlorophyll, and a range of analyses for nitrogen and phosphorus were made in support of bioassays. Consideration was given to both statistical and biological interpretation of the assays. The study did not produce a clear guide to the assessment of nutrient limitation among natural plankton communities. The phosphorus bioassays assess depletion of storage products rather than the levels of phosphorus in cells at which growth becomes limited. The same is true for most of the nitrogen bioassays, with the added complication that the analytical procedures may be too insensitive to assess depletion of storage products. Some advance can be made in understanding the nutrient status of planktonic communities at least in these 12 lakes, because it is possible to assemble a package of bioassays and measurements with criteria which identify waters in which nutrient limitation by either nitrogen or phosphorus is not operative. The data indicate that the storage capacity for phosphorus is c. x5 the subsistence level, and that for nitrogen may be only c. x0.5. If the storage capacity for phosphorus is indeed an order of magnitude greater than that for nitrogen, then phosphorus storage products must be depleted to 10% of their maximum before phosphorus limitation of plant growth becomes a possibility. (Moore-IVI)
W86-01911

INVESTIGATION OF SAMPLING STRATEGIES FOR LAKE BENTHOS,
Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
B. V. Timms.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 71-78, 1985. 1 Fig, 6 Tab, 27 Ref.

Descriptors: *Benthos, *Sampling, *Lakes, Seasonal variation, Lake Pearson, New Zealand, Line transects, Abundance, Population dynamics.

Lake benthos is difficult to sample to obtain accurate estimates of population parameters. Part of the apparent variation in community structure and abundance of macrobenthos between lakes is attributable to the different sampling strategies used. Sampling was carried at Lake Pearson, Canterbury, New Zealand monthly from August 1978 to July 1979 at 12 sampling stations. A comparison of 7 sampling options shows that spot samples and line transects are inadequate but that an augmented line transect is almost as good as stratified random sampling. Winter/early spring and summer samples are needed to account for seasonal variations in species richness and community biomass. Much less effort is required for an augmented line transect, therefore it is recommended for lake survey and management studies. If large species such as mussels occur, it should be realized that this program is inadequate to sample them and either numerous grabs are needed in one period or over a seasonal cycle, or some other sampler should be used. (Moore-IVI)
W86-01913

2I. Water In Plants

EFFECTS OF WATER AND MINERAL NUTRIENT SUPPLY ON A DECIDUOUS AND AN EVERGREEN DWARF SHRUB: VACCINIUM ULIGINOSUM L. AND V. VITIS-IDAEA L.,
Lund Univ. (Sweden). Dept. of Plant Ecology.
P. S. Karlsson.
Holarctic Ecology, Vol. 8, No. 1, p 1-8, March, 1985. 6 Fig, 2 Tab, 51 Ref.

Descriptors: *Nutrients, *Minerals, *Water requirements, Plant growth, Fertilization, Soil properties, Climate, Precipitation, Roots, Evergreen shrubs, Deciduous shrubs.

At time of harvest, in response to fertilization, the deciduous Vaccinium uliginosum had accumulated more nutrients and grown more than the evergreen V. vitis-idaea. This study aimed at testing whether a similar response would be obtained in these species after fertilizing a site that differed from that used in the earlier study both in soil and climate characteristics. The present study was conducted at Abisko, northern Sweden, at a well drained site with a thin layer of organic soil, no permafrost, and relatively low annual precipitation. It is concluded that a sized response pattern cannot be expected for evergreen and deciduous species without considering other plant characteristics such as the amount of roots and (perhaps still more important) the spatial distribution of the roots in the soil. Such differences within a growth form group may be further accentuated by differences in climate, mainly precipitation, and soil quality between sites. The different response patterns recorded for V. vitis-idaea and V. uliginosum in the present study as compared to the earlier study may be result of such site differences. (Baker-IVI)
W86-01360

CANOPY TRANSPIRATION AND WATER FLUXES IN THE XYLEM OF THE TRUNK OF LARIX AND PICEA TREES - A COMPARISON OF XYLEM FLOW, POROMETER AND CUVETTE MEASUREMENTS,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
E. D. Schulze, J. Cermak, R. Matyssek, M. Penka, and R. Zimmermann.
Oecologia, Vol. 66, No. 4, p 475-483, July, 1985. 7 Fig, 1 Tab, 38 Ref.

Descriptors: *Canopy, *Transpiration, *Xylem, *Trees, *Larix, *Picea, *Porometers, Plant tissues, Plant physiology, Leaves.

Leaf gas exchange, transpiration, water potential and xylem water flow measurements were used in order to investigate the daily water balance of intact, naturally growing, adult Larix and Picea trees without major injury. The total daily water use of the tree was very similar when measured as xylem water flow at breast height or at the trunk top below the shade branches, or as canopy transpiration by a porometer or gas exchange chamber at different crown positions. The average canopy transpiration is about 12% lower than the transpiration of a single twig in the sun crown of Larix and Picea. Despite the similarity in daily total water flows there are larger differences in the actual daily course. Transpiration started 2 to 3 h earlier than the xylem water flow and decreased at noon before the maximum xylem water flow was reached, and stopped in the evening 2 to 3 h earlier than the water flow through the stem. The daily course of the xylem water flow was very similar at the trunk base and top below the lowest branches with shade needles. The difference in water efflux from the crown via transpiration and the water influx from the trunk is caused by the use of stored water. The specific capacitance of the crown wood was estimated to be 4.7 x 10 to the minus 8th power and 6.3 x 10 to the minus 8th power kg/kg/Pa and the total amount of available water storage was 17.8 and 8.7 kg, which is 24% and 14% of the total daily transpiration in Larix and Picea respectively. Very little water was used from the main tree trunk. With increasing transpiration and use of stored water from wood in the crown, the water potential in the foliage decreases. Plant water status recovers with the decrease of transpiration and the refilling of the water storage sites. The liquid flow conductance in the trunk was 0.45 x 10 to the minus 9th power and 0.36 x 10 to the minus 9th power mol/sq m/s/Pa in Larix and Picea respectively. The role of stomata and their control by environmental and internal plant factors is discussed. (Author's abstract)
W86-01601

COMPARATIVE WATER RELATIONS OF ADJACENT CALIFORNIA SHRUB AND GRASSLAND COMMUNITIES,
Pepperdine Univ., Malibu, CA. Natural Science Div.
S. D. Davis, and H. A. Mooney.
Oecologia, Vol. 66, No. 4, p 522-529, July, 1985. 10 Fig, 1 Tab, 34 Ref.

Descriptors: *California, *Grasslands, *Shrubs, *Plant physiology, Chaparral, Drought, Water stress, Plant populations, Soil moisture.

Much of the coastal mountains and foothills of central and southern California are covered by a mosaic of grassland, coastal sage scrub, and evergreen sclerophyllous shrubs (chaparral). In many cases, the borders between adjacent plant communities are stable. The cause of this stability is unknown. The water use patterns of representative grasses, herbs, and shrubs across a grassland/chaparrel ecotone were examined and the extent to which patterns of water use contribute to ecotone stability was determined. The effects of seed dispersal and animal herbivory were also examined. During spring months, when water was not limited, grassland species had a much higher leaf conductance to water vapor diffusion than chaparral plants. As the summer drought progressed, grassland species depleted available soil moisture first, bare zone plants second, and chaparral third, with one chaparral species (Quercus durata) showing no evidence of water stress. Soil moisture depletion patterns with depth and time corresponded to plant water status and root depth. Rabbit herbivory was highest in the chaparral and bare zone as indicated by high densities of rabbit pellets. Dispersal of grassland seeds into the chararral and bare zone was low. Results support the hypothesis that grassland species deplete soil moisture in the upper soil horizon early in the drought, preventing the establishment of chaparral seedlings or bare zone herbs. Also, grassland plants are prevented from invading the chaparral because of low seed dispersability and high animal herbivory in these regions. (Author's abstract)
W86-01602

WATER RELATIONS OF PINUS RADIATA IN COMPETITION WITH WEEDS,
Melbourne Univ., Parkville (Australia). Forestry Section.
R. Sands, and E. K. S. Nambiar.
Canadian Journal of Forest Research, Vol. 14, No. 2, p 233-237, 1985. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Pine trees, *Water stress, *Competition, *Weeds, Stomatal resistance, Water potentials, Needles, Roots, Diurnal variation.

Soil water profiles up to 2 m in depth and diurnal patterns of needle water potential and stomatal resistance were measured over a dry summer period in 5-, 16-, and 28-month-old radiata pine (Pinus radiata D. Don) plantations, growing with and without weed competition. Severe water stress with consequent productivity loss occurred in trees with weed competition but the severity of stress decreased progressively with increasing tree age. Transplanted seedlings in their first growing season had shallow root systems which could not efficiently exploit water at depth. By contrast, seedlings in their second and third growing seasons

extracted water from at least a depth of 2 m. Trees without weed competition were not water stressed over this period even when planted at three times their normal stocking rate. Thus there is considerable capacity to increase early growth rates of radiata pine without water being the limit to growth if weeds are adequately controlled. (Author's abstract)
W86-01777

ESTIMATION OF TWIG XYLEM WATER POTENTIAL IN YOUNG DOUGLAS-FIR TREES,
British Columbia Univ., Vancouver. Dept. of Soil Science.
F. M. Kelliher, T. A. Black, and A. G. Barr.
Canadian Journal of Forest Research, Vol. 14, No. 4, p 481-487, August, 1984. 7 Fig, 3 Tab, 49 Ref.

Descriptors: *Water potential, *Fir trees, *Xylem, Soil water potential, Transpiration, Needles, Water stress.

Tree water stress can be an important factor determining productivity of some North American conifer forests. Leaf (needle) water potential is a measure of tree water stress. A method is described which can be used to estimate twig xylem water potential for 10-15 m tall Douglas-fir (Pseudotsuga menziesii) trees. Using pressure chamber measurements, values of needle xylem water pressure potential were found to be similar to twig xylem water pressure potential. Pressure chamber measurements were reproducible and needle deformation was not observed. For root zone soil water potential > -0.4 MPa, measured predawn total twig xylem water potential of these Douglas-fir trees was significantly less than the soil water potential. A transpiration rate dependent single soil to twig liquid resistance accounted for the difference between predawn total twig xylem water potential and soil water potential. For soil water potential > -0.4 MPa, during the daytime when transpiration was high, twig liquid resistance could be described by a logarithmic function of soil water potential. The effect of capacitance on twig xylem water potential was small. A model incorporating the transpiration dependent twig liquid resistance accurately estimated the course of twig xylem water potential on a clear day when soil water potential was -0.04 MPa. (Moore-IVI)
W86-01781

INSTRUMENT FOR MEASURING THE AVERAGE STOMATAL CONDUCTANCE OF CONIFER SEEDLINGS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
N. J. Livingston, T. A. Black, D. Beames, and B. G. Dunsworth.
Canadian Journal of Forest Research, Vol. 14, No. 4, p 512-517, August, 1984. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Stomatal conductance, *Conifers, *Measuring instruments, Porometers, Conductance, Fir trees, Seedlings, Microprocessors.

A ventilated, transient-type porometer was designed to nondestructively measure the average stomatal conductance of conifer seedlings. The porometer consists of a low-power microprocessor unit and a stainless steel chamber which encloses the seedling. Conductance is calculated from the measured rate of increase in chamber relative humidity above the ambient level. Consequently, chamber air does not have to be dried prior to measurement. Direct readout of stomatal conductance is provided by means of liquid crystal display and a serial (RS232) port. Porometer calibration over a range of humidities showed that the effective chamber volume was consistently 25% larger than the actual chamber volume. Stomatal conductance measurements made on Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) seedlings using the porometer agreed well with average values obtained with a ventilated diffusion porometer using four needle samples. The porometer proved to be very convenient to use in a forest clearcut environment, with the measurement procedure taking about 1 min. Measurements can be made on a seedling over the growing season because the use of the instrument causes no injury to stem, branches, and needles. (Author's abstract)
W86-01782

LIGHT REDUCTION AND MOISTURE STRESS: EFFECTS ON GROWTH AND WATER RELATIONS OF WESTERN LARCH SEEDLINGS,
Oregon State Univ., Corvallis. Coll. of Forestry.
N. C. Vance, and S. W. Running.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 72-77, February, 1985. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Larch trees, *Water stress, *Plant growth, Solar radiation, Leaves, Water potential, Seedlings, Humidity, Conductance.

Ten-week-old western larch (Larix occidentalis Nutt.) seedlings were grown in a greenhouse under 70, 37, and 27% full sunlight from late July to early October. In August, seedlings under each light treatment were repetitively water stressed until predawn leaf water potential reached one of three levels: no stress (> -0.4 MPa), moderate stress (-0.7 to -1.0 MPa), and severe stress (-1.5 to -1.8 MPa). Moisture stressing significantly reduced height and diameter of seedlings grown under 70% light. Light reduction reduced shoot and root biomass accumulation. A positive linear relation was found between root dry weight and light intensity. The largest seedlings (on a weight basis) received the highest light, were unstressed, and had the lowest shoot/root ratios. Terminal bud set was not affected by light reduction or moisture stressing but occurred under a 14-h photoperiod and reduced nighttime temperatures. Stressed and shaded seedlings had significantly reduced diurnal leaf conductance (K1), and stress-cycled seedlings showed an adjustment to stressing. The K1 of unstressed seedlings was correlated with humidity deficit (ABHD), and K1 of stressed seedlings, with leaf water potential and ABHD. Maximum K1 declined with decreasing leaf water potential but not to a level indicating complete stomatal closure. (Author's abstract)
W86-01785

NEEDLE WATER POTENTIAL AND SOIL-TO-FOLIAGE FLOW RESISTANCE DURING SOIL DRYING: A COMPARISON OF DOUGLAS-FIR, WESTERN HEMLOCK, AND MOUNTAIN HEMLOCK,
British Columbia Univ., Vancouver. Dept. of Soil Science.
T. M. Ballard, and M. G. Dosskey.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 185-188, February, 1985. 3 Fig, 13 Ref.

Descriptors: *Needles, *Water potential, *Plant water uptake, *Soil water, *Hemlock, *Fir trees, Seedlings, Soil water potential, Water uptake resistance.

Trends of needle water potential and resistance to water uptake by Douglas-fir seedlings are compared to those for western and mountain hemlock. Soil-to-foliage flow resistance for various soil water potentials was calculated as the difference between soil and needle water potentials, divided by the corresponding water uptake rate. Needle water potential in western and mountain hemlock falls as the soil dries, but under the experimental conditions, it remained stable in Douglas-fir. Resistance to water flow from soil to foliage is higher for the hemlocks and increases more steeply as the soil dries. As the soil continues to dry, the effect of larger and more steeply increasing resistance, in hemlocks, is to decrease water uptake to near zero, long before the water potential difference becomes very small. This occurs although root surface area is much greater for the hemlocks than for Douglas-fir, and is especially pronounced for mountain hemlock. (Moore-IVI)
W86-01787

2J. Erosion and Sedimentation

SEDIMENT RESUSPENSION AND CURRENTS IN LAKE MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.

For primary bibliographic entry see Field 2H.
W86-01341

HYDROLOGY OF MID-ALTITUDE TUSSOCK GRASSLANDS, UPPER WAIPORI CATCHMENT, OTAGO. I. EROSION, SEDIMENT YIELDS AND WATER QUALITY,
New Zealand Forest Service, Rotorua. Forest Research Inst.
C. L. O'Loughlin, L. K. Rowek, and A. J. Pearce.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 45-59, 1984. 6 Fig, 4 Tab, 16 Ref.

Descriptors: *Soil erosion, *Sediment yield, *Water quality, *Grasslands, *Otago, *New Zealand, Temperature effects, Turbidity, Bank stabilization, Catchment area, Hydrology.

A study was designed to determine the erosion status of catchments under lightly modified tussock grassland and to examine the export of sediment from the catchment. The quality of the catchments' streamwater was also considered. Sediment yields from two small tussock catchments underlain by schist bedrock in the East Otago uplands South Island, New Zealand, were 42.8 cubic m and 12.6 cubic m respectively during a 4 year period of study. The area appears to have low erosion rates, as evidenced by the sediment yield rates. Surface erosion and mass wasting were not common occurrences on the catchments' slopes. Most of the sediment delivered to the streams derived from channel scouring and bank collapse during large floods. Suspended sediment concentrations ranged from less than 2 mg/l to 430 mg/l and the streamwaters remained clear at less than 15-20 mg/l sediment concentration for about 97% of the time. Stream pH averaged 6.8, stream conductivity ranged from 12.4 to 54.8 micro-S/cm and stream temperature ranged between maxima of 16 to 19 degrees C in summer and minima of 0-3 degrees C in winter. (Baker-IVI)
W86-01383

SOME THOUGHTS ON FINE-GRAINED SEDIMENT TRANSPORT AND DEPOSITION,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
D. S. Gorsline.
Sedimentary Geology, Vol. 41, No. 2/4, p 113-130, December, 1984. 118 Ref.

Descriptors: *Sediment transport, *Deposition, Sedimentation, Particulate matter, Plankton, Marine environment.

Some aspects of fine-grained sedimentary research are reviewed. Water circulation is instrumental in determining the distribution of these particulates. Planktonic biologic filtering, aggregation, and reworking are of primary importance in deposition. Early diagenesis is controlled by bacterial processes with consequent changes in bulk and chemical properties. Initial deposition of most fine particulates is in the continental margins and then it moves to deep-ocean floors by mass wasting and high concentration flows. The stability of these fine deposits even on slopes of gentle gradient is controlled primarily by water content which, in turn, is a function of sedimentation rate and texture of the supply. Mass transport can occur in a variety of forms from slow creep to catastrophic failures of large scale. The various forms of movement can cause a sequence of morphologies. Most of the fine-grained stratigraphic record urgently needs reevaluation and restudy. Models of paleogeographic reconstructions on a large scale need to include the results of physical and biological oceanographers as the older simpler scenarios of locations of zones of high bioproductivity and of the patterns of major ocean currents have been greatly modified in recent studies. (Baker-IVI)
W86-01397

CHANGES IN SEDIMENT COMPOSITION DURING SEASONAL RESUSPENSION IN SMALL SHALLOW DIMICTIC INLAND LAKES,
Wisconsin Univ.-Platteville. Dept. of Geosciences.

E. B. Nuhfer, and R. Y. Anderson.
Sedimentary Geology, Vol. 41, No. 2/4, p 131-158, December, 1984. 13 Fig, 5 Tab, 36 Ref.

Descriptors: *Resuspension, *Sedimentation, *Lake sediments, Edinboro Lake, Pennsylvania, East Twin Lake, Ohio, Kettle lakes, Chemical analysis, Calcium, Phosphorus, Sulfur, Magnesium, Sodium, Zinc, Nickel, Chromium, Manganese, Iron, Aluminum, Seasonal variation.

Results are presented of resuspension studies at two small shallow kettle lakes, Edinboro Lake, Pennsylvania, and East Twin Lake, Ohio. These lakes have significant amounts of seasonal resuspension and measurable accompanying variations in seston with respect to chemistry, mineralogy, and petrography. The objectives of the work were to study the magnitude and duration of resuspension events; and to acquire sufficient chemical, mineralogical, and petrographic data from an annual record to permit both detection of seasonal variations and statistical analyses of relative importance of detected variations. Resuspension in the lakes occurs from both seasonal holomictic circulation and from continual entrainment of material from the shallow portions of the lake by the circulating epilimnion. Trapping rates were only negligibly affected by rainstorms. These rates varied widely throughout the year with minimum sedimentation rates noted at time of winter ice cover, and maximum rates noted during autumn circulation. Most material collected by the sediment traps was resuspended from the lake bottom. The only inactive time for resuspension was the time period under winter ice cover. Compositional variations included enrichment of Si in winter, Ca, P, S, Mg, Na, Zn, Ni, and Cr in summer, and Mn in late summer and autumn. During times of reduced circulation the sediment is generally enriched in amorphous mineraloids and during spring and autumn, in detrital minerals. Endogenic minerals include calcite, pyrite, and possibly some kaolinite. Most of the mineral fraction is detrital. Trap sample differs in composition from bottom sediment, but samples collected in traps in early winter closely resemble bottom material. Traping rates in early winter appear closest to true rates of fill. (Baker-IVI)
W86-01398

FURTHER EVIDENCE OF FINE-GRAINED SEDIMENT DISPERSAL IN THE SOUTHEASTERN YELLOW SEA,
Seoul National Univ. (Republic of Korea). Dept. of Oceanography.
S. K. Chough.
Sedimentary Geology, Vol. 41, No. 2/4, p 159-172, December, 1984. 8 Fig, 31 Ref.

Descriptors: *Sedimentation, *Dispersion, *Yellow Sea, China, Korea, Yangtze River, Hwangho River, Keum Estuary, Kaolinite, Chlorite, Mineralogy, Sediment transport.

The Yellow Sea is a shallow, post-glacially submerged epicontinental basin, a tectonically stable depocenter of clastics derived from the adjoining land masses of China and Korea. Sediments in the Yellow Sea are fine-grained in the broad western part, where they are derived mainly from the Chinese rivers, the Hwangho and Yangtze, and coarse-grained in the narrow eastern part originating largely from the Korean Peninsula. The coarse grained sediments near the Keum Estuary contain subtantial amounts of fine fractions. Kaolinite and chlorite are abundant in the fine fractions for about 120 km both toward the northwest and the southwest. Trace elements distributed in the bulk sediments follow the same trends. The close correspondence between mineralogical and geochemical evidence and hydrographic data suggests that the bulk of fine-grained sediments in the southeastern Yellow Sea originates from the Keum River and is subsequently transported by prevailing nearshore currents both northwestward during summer and dominantly southwestward in winter. Illite is dominant in the rest of the sea as influenced by discharge of Hwangho River and possibly also the Yangtze. There appears only to be a minimal effect from the Kuroshio discharging into the southeastern Yellow Sea. (Baker-IVI)
W86-01399

SOIL EROSION MEASUREMENT AND SOIL CONSERVATION RESEARCH IN CULTIVATED AREAS OF THE UK,
National Coll. of Agricultural Engineering, Silsoe (England).
R. P. C. Morgan.
Geographical Journal, Vol. 151, No. 1, p 11-20, March, 1985. 7 Tab, 62 Ref.

Descriptors: *Soil erosion, *Soil conservation, *Erosion control, *England, *Cultivated lands, Rill erosion, Wind erosion, Slope, Soil types.

Agricultural soil erosion by both water and wind is a local scale problem in the UK, particularly on the sandy loam soils under continuous cereal production or market gardening in the midland and eastern counties of England. Mean annual rates of soil erosion by water on these soils in fields on hillslopes up to 11 degrees can exceed 2 kg/sq m when rilling occurs, compared with a rate for top soil renewal of only about 0.1 kg/sq m. Rates as high as 1.9 kg/sq m have been recorded in individual storms and storm rates greater than 0.2 kg/sq m can occur as frequently as in four years out of seven. Storm losses by wind erosion are of similar magnitude but those for gully erosion are much higher with rates reaching 15 to 19 kg/sq m in single storms. Research into soil conservation has been carried out on Experimental Husbandry Farms and by farmers and commercial organizations with a direct interest in the problem. It has been largely limited to the use of shelterbelts, guard crops, soil stablizers and land imprinting or pressing to control wind erosion with virtually no work having been undertaken on water erosion control. There is a need for more fundamental research which will allow the mechanics of the control measures to be understood better and to enable their general applicability to be assessed more readily. Research projects with these aims in mind are described involving investigations of the effects of crop cover on splash erosion, tillage effects on soil erodibility and the simple modelling of the erosion system to predict the stability or instability of the soil resource under given systems of agricultural management. (Author's abstract)
W86-01401

SOIL EROSION AND SEDIMENT TRANSPORT RESEARCH IN TROPICAL AFRICA,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
R. Lal.
Hydrological Sciences Journal, Vol. 30, No. 2, p 239-256, June, 1985. 3 Fig, 3 Tab, 107 Ref.

Descriptors: *Soil erosion, *Erosion, *Sediment transport, *Africa, *Research, Sediment load, Land use, Deforestation, Environmental protection.

The magnitude of soil erosion in tropical Africa is reviewed and related to erodibility, erosivity and landform in different ecological regions. There are few direct measurements of erosivity and erodibility in tropical Africa and the relevance of using the Universal Soil Loss Equation in estimating these parameters is reviewed. Soil erodibility is not a fixed parameter and changes with time. Although localized rates of soil erosion can be high, the erosion rates derived from sediment loads in rivers are often low. Most of the available data on sediment loads of African rivers are 10-20 years old, and little research information is available on the delivery ratios associated with different catchments. Rapidly changing land use is one of the major factors responsible for accelerated soil erosion, and the effects of deforestation, grazing, fire, and of cultural practices are discussed. The economics of soil erosion is reviewed in terms of loss in productivity and siltation of reservoirs. Research and development needs are listed. (Author's abstract)
W86-01447

ESTIMATING UNIVERSAL SOIL LOSS EQUATION FACTOR VALUES WITH AERIAL PHOTOGRAPHY,
Ministry of Works and Development, Palmerston North (New Zealand). Water and Soil Div.
P. R. Stephens, J. K. MacMillan, J. L. Daigle, and J. Cihlar.
Journal of Soil and Water Conservation, Vol. 40, No. 3, p 293-296, May-June, 1985. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Aerial photography, *Infrared imagery, *Soil loss, Soil erosion, Mapping, Crop rotation, Farm management, Slope, Soil type, Remote sensing, Croplands.

Traditionally, inputs for the universal soil loss equation have been based on cropland and soil erosion estimates obtained from field surveys and farmer interviews. But such data can also be obtained by using color-infrared photographs to delineate (a) homogeneous erosion mapping units, crop rotations, and management practices; (b) topographic maps for slope information; and (c) an improved soil map for soil erodibility. This new procedure was tested in a potato growing area near Grand Falls, New Brunswick. With accurate soil erodibility data, soil loss was estimated with an accuracy of 88% +/- 1.2% compared to the traditional method. Such accuracy is sufficient for farm conservation planning. Accuracy dropped to 72% +/- 2.5% when the existing soil map (1:63,360-scale) was used. The new method is two to four times faster and permits year-round mapping, compared to about 120 days for the traditional method in the study area. Aerial photographs also provide a valuable land cover record for future use. (Author's abstract)
W86-01493

NITROGEN MINERALIZATION IN A SEQUENCE OF HYDROMORPHIC SOILS IN A VALLEY IN THE HIGH SEMOIS (BELGIUM) (MINERALISATION DE L'AZOTE DANS UNE SEQUENCE DE SOLS HYDROMORPHES DE LA VALLEE DE LA HAUTE SEMOIS (BELGIQUE)),
Universite Libre de Bruxelles (Belgium). Lab. de Botanique Systematique et d'Ecologie.
For primary bibliographic entry see Field 2G.
W86-01510

GENERALIZED CONTINUUM THEORY FOR MULTIPHASE SUSPENSION FLOWS,
Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Industrial Engineering.
G. Ahmadi.
International Journal of Engineering Science, Vol. 23, No. 1, p 1-25, July, 1985. 118 Ref.

Descriptors: *Continuum theory, *Suspended solids, *Multiphase suspension flow, Particulate matter, Thermodynamics, Mathematical equations, Sedimentation.

A continuum theory for multiphase particulate suspensions in a fluid media is formulated. The generalized fundamental balance laws for the particulate phases as well as for the continuous suspending fluid phase are presented. The thermodynamics of a multiphase system is studied and the method of Lagrangian multipliers is employed to include the constraints of incompressibility of materials of the constituents and the criterion for fully saturated media. Constitutive equations are developed which include microrotational and microdilational effects. The basic equations of motion of different phases are derived and discussed. Special considerations are given to the case of incompressible constituents. Examples of applications of the present theory to dilute suspension flows and multiphase sedimentation are also discussed. (Author's abstract)
W86-01533

FORMATION OF RIPPLES IN ERODIBLE CHANNELS,
Delaware Univ., Newark. Ocean Engineering Program.
N. Kobayashi, and O. S. Madsen.
Journal of Geophysical Research, Vol. 90, No. C4, p 7332-7340, July, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Ripple marks, *Erodible channels, *Hydrodynamic models, *Model studies, Hydraulics, Fluid mechanics, Sediment.

Formation of ripples and dunes in erodible channels was analyzed by using the hydrodynamic model developed by Kobayashi and Madsen. Applying the continuity equation of sediment, the propagation velocity of the wavy bed is expressed in terms of the new fluxes of bed load along the wavy bed and suspended sediment out of the bed load transport layer. The spatial variation of the bed load transport rate is derived by analyzing the balance of forces acting on a representative bed load particle on a sloping bed. The net flux of the suspended sediment out of the bed load transport layer is obtained by solving the diffusion equation for the suspended sediment near the bed. The stability analysis predicts that a perturbation that is either fairly short or long relative to the depth of flow will initially grow, depending on whether the flow is hydraulically smooth or fully rough. The model explains why ripples are not observed in experiments involving fairly coarse sediments, since in these cases the flow is rough turbulent. (Author's abstract)
W86-01538

THEORETICAL MODEL FOR SALTATING GRAINS IN WATER,
Washington Univ., Seattle. Geophysics Program.
P. L. Wiberg, and J. D. Smith.
Journal of Geophysical Research, Vol. 90, No. C4, p 7341-7354, July, 1985. 17 Fig, 2 Tab, 30 Ref.

Descriptors: *Sediment transport, *Geophysics, *Saltation, Streambeds, Particulate matter, Model studies, Fluid mechanics.

The equations of motion for a sediment grain near a noncohesive bed and those for the local fluid flow are combined to produce a set of differential equations that can be solved numerically to describe the trajectory of a saltating grain as a function of time. The lift coefficient is set based on a reanalysis of data produced by Chepil, and the other parameters of the problem are set using standard fluid mechanical relationships; the initial velocity and position are specified with a separate model. The heights of the resulting trajectories are found to be significantly lower than available measurements would indicate; therefore two extensions of the model are examined: the effect that spin lift and form lift have on a series of trajectories, and the effect of partially elastic collisions between a moving grain and the bed over which it is traveling. A model that includes the second process is less complicated than one that includes the first, and it yields trajectories that agree very well with available experimental measurements when a rebound coefficient that varies around 0.5 and depends on the impact momentum is used. The model provides a reasonable representation of saltation in water and both fluid-solid and solid-solid interactions are required to reproduce the parameters of measured trajectories. (Author's abstract)
W86-01539

CHARACTERISTICS OF SUSPENDED SEDIMENT TRANSPORT IN THE LOWER HUDSON RIVER,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
H. Bokuniewicz, and C. L. Arnold.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 184-189. 2 Fig, 1 Tab, 29 Ref.

Descriptors: *Sediment transport, *Hudson River, *New York, *Suspended sediment, Particle size, Path of pollutants, Estuarine environment, Physicochemical characteristics.

Fine-grained suspended particles, and the contaminants associated with them, undergo episodic transport in their downstream migration and do not necessarily follow the water motion. Below the dam at Troy, NY, the suspended sediment transport is substantially modified by tidal resuspension and biological agglomeration. Samples taken seasonally at 16 stations had an average concentration of 30 mg/l ranging from 28 mg/l during low freshwater discharge to 40 mg/l at times of high discharge. The concentrations were increasingly controlled by tidal resuspension towards the month where tidal discharges are typically 20 times the freshwater discharge. The average percentage weight loss on ignition was 22%. Measurements of the particle-size distributions in both undisturbed and disaggregated samples showed that suspended particles were usually mineral-organic aggregates. In contrast to resuspension which increases the time particles spend in the water column, agglomeration tends to decrease that time by increasing the settling velocity. Most of the fine-grained sediment distribution occurs in the geochemical estuary and a substantial amount of this sediment is ultimately dredged and disposed in the ocean. (Author's abstract)
W86-01559

SEDIMENT ACCUMULATION RATES IN IRONDEQUOIT BAY, NEW YORK BASED ON LEAD-210 AND CESIUM-137 GEOCHRONOLOGY,
Geological Survey, San Diego, CA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W86-01566

MINERALIZATION OF ORGANIC CARBON ON AND IN THE SEDIMENT OF LAKE GREVELINGEN,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01579

FORMATION OF PYRITE IN FRESHWATER SEDIMENTS: IMPLICATIONS FOR C/S RATIOS,
Freshwater Biological Association, Ambleside (England).
W. Davison, J. P. Lishman, and J. Hilton.
Geochimica et Cosmochimica Acta, Vol. 49, No.7, p 1615-1620, July, 1985. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Pyrite, *Sediments, *Carbon/sulfur ratio, Lake sediments, Redox status, Volatile compounds, Sulfur.

The vertical distribution of pyrite, acid volatile sulfide (AVS), carbon, and total S (St) were determined directly in the sediments of three lakes of different trophic status. The results showed that freshwater pyrite formation reflects the redox status of the sediment of overlying waters. It appears to form chiefly in reducing sediments which are subject to oxidizing influences, by either a low turnover of organic carbon or periodic incursions of oxygen. Although there are high concentrations of AVS in the near-surface sediments of productive lakes, very little is diagenetically converted to pyrite. The feasibility of using sulfur ratios to diagnose whether rocks were formed in marine or freshwater environments is assessed. New values for FeS2/S of 0.5-5 show that this ratio does not provide a reliable test. Values of C/Sp, where Sp represents pyrite sulfur, lie within the range of 160-700 and are much higher than previously measured ratios of C/St of 1-50. These new determinations show that, if pyrite sulfur is unequivocally measured, C/S ratios may be a more sensitive indicator of salinity than had been previously thought. (Author's abstract)
W86-01615

ENERGY APPROACH TO ESTIMATING SCOUR DOWNSTREAM OF A LARGE DAM,
Vancouver (British Columbia).
For primary bibliographic entry see Field 8B.
W86-01694

USING CREAMS AND ECONOMIC MODELING TO EVALUATE CONSERVATION PRACTICES: AN APPLICATION,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 5B.
W86-01715

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-01731

DETERMINATION OF RIPPLE GEOMETRY,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-01732

PREDICTION OF 2-D BED TOPOGRAPHY IN RIVERS,
Waterloopkundig Lab. te Delft (Netherlands).
N. Struiksma.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1169-1182, August, 1985. 7 Fig, 2 Tab, 12 Ref, 1 Append.

Descriptors: *River beds, *Topography, *Mathematical models, Bed load, Sediment transport, River mechanics, River morphology.

Mathematical models are being developed at the Delft Hydraulics Laboratory for the computation of time-dependent, two-dimensional bed deformation in alluvial rivers. A most promising verification of the predictive capacity of one such model has been obtained for the Waal River in the Netherlands. This model was developed for rivers with dominant bed load transport without significant grain-sorting effects and with approximately constant width. Also, some results of computations with variable boundary conditions are given which simulate the effect of the river regime and the extraction and return of cooling water on the bed topography. (Author's abstract)
W86-01734

BRAHMAPUTRA RIVER, ASSAM, INDIA: PHYSIOGRAPHY, BASIN DENUDATION, AND CHANNEL AGGRADATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
D. C. Goswami.
Water Resources Research, Vol. 21, No. 7, p 959-978, July, 1985. 18 Fig, 6 Tab, 61 Ref.

Descriptors: *Brahmaputra River, *India, *Physiography, *Aggradation, *Erosion, Sediment transport, Suspended sediments, Sediment load, Channels, Himalayas, Geology.

The Brahmaputra River in Assam, India, characterized by high seasonal variability in flow, sediment transport, and channel configuration, experienced a secular period of aggradation from 1971 to 1979. The suspended load budget indicates an overall aggradation of the 607-km Assam reach of the Brahmaputra by about 16 cm during that period, with about 70% of the suspended sediment inflow into the reach being retained in the channel. Expressed as a percentage of the change in storage for the different reaches, computed errors due to sampling variability in sediment discharge generally lie within about 5-15% and do not appear to be large enough to affect the conclusions drawn from the suspended load budget. For a 145-km reach of the Brahmaputra, an alternative method based on measurement of channel cross sections suggests 21 cm of aggradation, somewhat more than estimated by the suspended load budget. Based on the suspended load carried by trans-Himalayan rivers, the present rate of denudation of the eastern Himalayas is estimated to be 73-157 cm/1000 years. The average rate for the last 2-3 million years, estimated from the volume of alluvial fill in the Brahmaputra valley in Assam, the sediment yield of the Himalayan rivers, and assuming a total yield to deposition ratio of 1.4 (present study), is 3 cm/1000 years. The current high rate of denudation of the Himalayas may be attributed mainly to the rapid uplift of the mountain system, recent earthquake activity, and high susceptibility of geologic formations to erosion by running water coupled with the effectiveness of the monsoon rainfall regime. (Author's abstract)

W86-01768

LIMITS ON THE USEFULNESS OF EROSION-HAZARD RATINGS: EXPERIENCES IN NORTHWESTERN CALIFORNIA,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 4D.
W86-01783

SHORELINE EVOLUTION ALONG THE NORTHERN COAST OF THE GULF OF MEXICO,
Louisiana State Univ., Baton Rouge. Dept. of Geology.
D. Nummedal, R. F. Cuomo, and S. Penland.
Shore and Beach, Vol. 52, No. 1, p 11-17, January, 1984. 12 Fig, 30 Ref.

Descriptors: *Erosion, *Coastal waters, *Shores, *Gulf of Mexico, *Louisiana, Sedimentation, Barrier islands, Sea level, Water level.

The change in position of the sedimentary shoreline along the coastal waters of Louisiana over time is a function of the relative rates of sedimentation and sea level change. The morphology and evolutionary history of barrier islands along the northern coast of the Gulf of Mexico clearly document how differences in the rates of sea level rise and sediment supply controls shoreline evolution. The development on the Mississippi deltaic plain in Louisiana has been one of episodic delta progradation, abandonment, and wave reworking of fluvial distributary sand bodies to generate flanking barrier islands. The central headlands have retreated by surface erosion; on the flanks a set of regressive barriers developed as long as they could be sustained by sediment supply from the eroding updrift headland. Rapid local relative sea level rises ultimately remove the source from the transport system. At that time, the flanking regressive barriers are drowned by the rising sea; the transgressive barriers on the central headland are probably removed by sustained shoreface retreat. Provided there is enough sand on the upper delta plain, a new cycle of barrier island development may be initiated. Rapid sea level rise facilitates the drowning of major coastal barriers and sudden, dramatic landward shifts in the shoreline. Slower rates of sea level rise permit the local development of large regressive sequences as long as sediment supply is present. The ultimate fate of the shoreline under this regime appears to be shoreface erosion of nearly the complete coastal depositional sequence. (Baker-IVI)
W86-01830

COASTAL EROSION IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. Morelock.
Shore and Beach, Vol. 52, No. 1, p 18-27, January, 1984. 21 Fig, 4 Ref.

Descriptors: *Puerto Rico, *Erosion, *Coasts, Erosion control, Aerial photography, Beach erosion, Accretion, Flood control.

Using a series of aerial photographs from 1936, 1950-51, 1962-63, 1971, and 1977, ten sites of severe coastal erosion in Puerto Rico were studied. El Tuque Park is a public beach west of Ponce. From 1971 to 1977 the straightened shoreline at the most rapidly eroding sites had a rate of erosion of 1.7 m/yr, which compares favorably with the rate of loss of shoreline at this point from 1962 to 1971 which was 7.2 m/yr. At Playa Cortada the present pattern of erosion poses a problem for houses that were built at the waterfront east of the old pier. Aguada has a beach which is a partial foreshore that terminates in an eroding cliff reached by high wave conditions. The period of accretion from 1937 to 1950 may have been caused by an influx of flood sediments. Between 1950 and 1977 there has been a loss of 25 m of shoreline, and the rate of erosion has been increasing. The area has changed from a developed beach profile to the partial foreshore as erosion moved inland and cut into higher ground. At Punta Salinas major modifications have been carried out. The Bayamon River has been closed off from discharge into the bay and flood control channels and jetties have been built to stem the tide of erosion. Isla Cabras, prior to 1971, gave no signs of erosional changes in the shoreline. Between 1971 and 1977, however, there is a drastic change at the southeast corner of the island with erosion occurring at a rate of 3.35 m/yr. Arecibo showed 35 m of shoreline retreat in the southern part of the bay between 1940 and 1959 for an annual rate of 1.7 m. The 1962 to 1971 photographs showed a moderate rate of erosion at the point of Punta Iglesia and a rate of 1.7 m/yr of eroding north of the sand borrow pit. Findings are also presented for Punta Uvero, Boca de Cangrejos, Pozuela, and Law Mareas. A program was recommended in 1978 which called for the classifying of the shoreline in terms of erosion hazard as a corollary to the flood warning classification of coastal areas. (Baker-IVI)
W86-01831

NEWLY DISCOVERED EVIDENCE FROM THE SAN DIEGO COUNTY AREA OF SOME PRINCIPLES OF COASTAL RETREAT,
Scripps Institution of Oceanography, La Jolla, CA.
G. G. Kuhn, and F. P. Shepard.
Shore and Beach, Vol. 51, No. 1, p 3-12, January, 1983. 20 Fig, 25 Ref.

Descriptors: *Erosion, *San Diego County, *California, Erosion control, Flood control, Shores, Coastal waters, Beach erosion, Breakwaters, Groundwater.

The study of coastal changes of San Diego County has thrown some light on coastal erosion along shoreline areas of moderate relief. The development of the breakwater at the entrance of San Diego Bay has demonstrated the importance of beach erosion in the vicinity of the Hotel Del Coronado. Artificial shoreline protection has become necessary in this same vicinity to forestall erosion where huge condominiums have recently been constructed on the sand. The study of Oceanside and areas to the south showed that the general interpretation of the dominance of southflowing sediment-transporting currents is not always applicable. Groundwater must have dissolved the calcareous sandstone cement along remnant shear zones in the Solana Beach area, producing caverns which weaken adjacent cliffs. The high cliffed area from Torrey Pines south to La Jolla show the importance of groundwater, accentuated by man's activities, and huge landslides. The low alluvial cliffs in the vicinity of Scripps Institution show the importance of changing weather cycles and coastal erosion since wide beaches develop during quiet periods with little cliff retreat and give a false sense of security to building sites along the bluff edges. (Baker-IVI)
W86-01832

BASIC PRINCIPLES OF SEDIMENT BUDGET STUDY IN THE COASTAL ZONE,
Odesskii Gosudarstvennyi Univ. (USSR).
For primary bibliographic entry see Field 2L.
W86-01834

COMPREHENSIVE STUDY OF THE COAST OF CALIFORNIA,
Army Engineer District, Los Angeles, CA.
For primary bibliographic entry see Field 2L.
W86-01837

TARAVAL VERTICAL SEA WALL,
San Francisco City, CA.
For primary bibliographic entry see Field 2L.
W86-01841

INLETS AND BARRIER BEACH DYNAMICS: A CASE STUDY OF SHINNECOCK INLET, NEW YORK,
Patchogue, New York.
For primary bibliographic entry see Field 2L.
W86-01843

COMPUTER ASSISTED MAPPING OF SOIL EROSION POTENTIAL,
British Columbia Ministry of Environment, Victoria. Surveys and Resource Mapping Branch.
T. Vold, M. W. Sondheim, and N. K. Nagpal.
Canadian Journal of Soil Science, Vol. 63, No. 3, p 411-418, August, 1985. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Soil erosion, *Erosion potential, *Mapping, *Computers, Algorithms, Soil properties, Soil loss, Slope.

Soil erosion potential maps and summary statistics can be produced from existing information with relative ease with the aid of computers. Soil maps are digitized and survey infomation is stored as attributes for each soil. Algorithms are then prepared which evaluate the appropriate data base attributes (e.g. texture, slope) for each interpretation. Forty surface soil erosion potential maps were produced for the Lower Fraser Valley which identify the most erosion-prone areas and indicate average potential soil losses to be expected under assumed conditions. The algorithm developed follows the universal soil loss equation. Differences across the landscape in the R, K, and S factors are taken into account whereas the L factor is considered as a constant equal to 1.0. Worst conditions of bare soil (no crop cover, i.e. C = 1.0) and no erosion control practices (i.e. P = 1.0) are assumed. The five surface soil erosion potential classes are determined by a weighted average annual soil loss value based both on the upper 20 cm of mineral soil and on the proportion of the various soils in the polygon. A unique polygon number shown on the erosion potential map provides a link to computer tables which give additional information for each individual soil within that polygon. (Author's abstract)
W86-01906

2K. Chemical Processes

PHYSICOCHEMISTRY OF THE UPPER GILA RIVER WATERSHED: II. INFLUENCE OF PRECIPITATION RUNOFF AND FLOOD EVENTS ON THE SAN FRANCISCO RIVER,
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
J. J. Rampe, R. D. Jackson, and M. R. Sommerfeld.
Journal of the Arizona-Nevada Academy of Science, Vol. 19, No. 2, p 115-120, 1984. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Physicochemical properties, *Rainfall runoff, *Floods, *San Francisco River, Arizona, New Mexico, Runoff, Storm runoff, Chlorides, Sodium, Nitrates, Phosphates, Ammonia.

The chemistry of a permanent desert stream is described during flooding with regard to changes in major anions and cations, nutrients, selected trace metals, and the interactions of the substances with suspended particulates. The San Francisco River is a permanent stream rising in the White Mountains and Mogollon Rim of eastern Arizona and western New Mexico. Flowing south and west it drains the Blue and Mogollon Mountains and receives its major tributary, the Blue River, 20 km northeast of Clifton, Arizona. The river discharges into the Gila River 12 km southwest of Clifton, above the Peconcillo Box Canyon. During two flood events stream turbidity increased 20-250 fold. During increased discharge chloride concentration decreased but the total quantity transported did not change. The ambient concentrations and loads of ammonia, nitrate and phosphate increased during flooding. Dissolved concentrations of major cations decreased by dilution, whereas sediment associated concentrations and total loads increased noticeably. Sodium was an exception since it was transported primarily into the dissolved form. Dissolved concentrations of trace elements either did not change or decreased slightly during flooding, whereas total concentration and transport increased dramatically. (Baker-IVI)
W86-01358

PRELIMINARY INVESTIGATION ON CHEMICAL QUALITY OF INLAND WATERS IN KENYA,
M. Moritsugu.
Berichte des Ohara Institut fur Landwirtschaftliche Biologie Okayama Universitat, Vol. 19, No. 1, p 25-34, March, 1985. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Chemical composition, *Water analysis, *Kenya, Acidity, Calcium, Magnesium, Sodium, Potassium, Carbonate, Conductivity, Salinity.

Electric conductivity, pH, calcium, magnesium, sodium, potassium and carbonate of the water were determined at twenty sites in Kenya in order to evaluate its usefulness for irrigation or tap water. Upstream waters were generally low in salinity as evidenced by Tana, Chania, Ndarugu and Thiririka River results. Waters downstream had a generally high salinity as exemplified by the lower Athi River. The waters of Lakes Naivasha and Baringo were fresh, while those of Lakes Magadi and Nakuru were sodic, even though they are situated in the Rift Valley and have no outflowing river. Except for upstream waters, natural Kenyan waters were alkaline, and carbonate contents in these waters were considerably high. The content of calcium in natural Kenyan waters and of magnesium in river waters was generally lower than in other countries. The sodium content of Kenyan waters in general was not so high as compared with other countries. The potassium content in the naturally available waters in Kenya was much higher than in the waters of other countries, and the average content was more than 8 ppm. (Baker-IVI)
W86-01361

AEROSOL CHEMISTRY IN MINNESOTA AND WISCONSIN AND ITS RELATION TO RAINFALL CHEMISTRY,
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
G. C. Pratt, and S. V. Krupa.
Atmospheric Environment, Vol. 19, No. 6, p 961-971, 1985. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Aerosols, *Minnesota, *Wisconsin, *Chemistry of precipitation, Chemical composition, Sulfates, Nitrates, Metals, Geochemistry.

Chemical characteristics of aerosol and rainfall samples collected at five sites in Minnesota and one site in west-central Wisconsin during the summer of 1982 were generally similar with respect to the relative proportions of major constituents. The most abundant species measured in the aerosol was sulfate, occurring predominantly in the fine fraction (< 2.5 micro-m aerodynamic diameter). The rain chemistry was also dominated by sulfate but not to the same extent as the aerosol. The concentrations of crustal materials in both the aerosol and the rain followed a gradient in which concentrations increased with proximity of the sampling site to the prairie. The concentrations of crustal materials in the aerosol were correlated with their concentrations in subsequent rain, whereas concentrations of other constituents were not significantly correlated between aerosol and rain. Since the aerosol was sampled at the surface this result provided evidence that crustal materials were transported at lower altitudes and were scavenged to a greater degree by below-cloud mechanisms. The measured components in aerosols were divided by factor analysis into: Ammonium sulfates; crustal materials; and a group containing nitrates, metals and other materials. (Author's abstract)
W86-01382

SOLUBILZATION EFFECTS OF SIMULATED ACID RAIN ON THE ORGANIC MATTER OF FOREST SOIL; PRELIMINARY RESULTS,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W86-01421

DECIPHERING HYDROLOGICAL SYSTEMS BY MEANS OF GEOCHEMICAL PROCESSES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W86-01448

ANNUAL LOSSES OF IRON FROM MOORLAND SOILS AND THEIR RELATION TO FREE IRON CONTENTS,
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W86-01468

CARBONATE CHEMISTRY OF RECENT CHALK GROUNDWATER IN A PART OF EAST ANGLIA, U.K.,
Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W86-01470

ESTIMATES OF AVERAGE MAJOR ION CONCENTRATIONS IN BULK PRECIPITATION AT TWO HIGH-ALTITUDE SITES NEAR THE CONTINENTAL DIVIDE IN SOUTHWESTERN COLORADO,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 5B.
W86-01515

DISTRIBUTION AND FLUX OF 226RA AND 228RA IN THE AMAZON RIVER ESTUARY,
Princeton Univ., NJ. Geophysical Fluid Dynamics Program.
For primary bibliographic entry see Field 2L.
W86-01535

IMPACT OF ALKALINE PARTICULATES ON PH OF RAIN WATER IN INDIA,
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 5B.
W86-01606

SHORT-TERM ENDPRODUCTS OF SULFATE REDUCTION IN A SALT MARSH: FORMATION OF ACID VOLATILE SULFIDES, ELEMENTAL SULFUR, AND PYRITE,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
For primary bibliographic entry see Field 2L.
W86-01614

FORMATION OF PYRITE IN FRESHWATER SEDIMENTS: IMPLICATIONS FOR C/S RATIOS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2J.
W86-01615

CHEMICAL COMPOSITION OF FOGWATER COLLECTED ALONG THE CALIFORNIA COAST,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W86-01620

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER - III; INORGANIC COMPOUNDS AND RADICALS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, H. Bader, W. R. Haag, and J. Staehelin.
Water Research, Vol. 19, No. 8, p 993-1004, 1985. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Ozone, *Reaction kinetics, *Inorganic compounds, *Free radicals, Sulfur compounds, Chlorine compounds, Nitrogen compounds, Water treatment, Chemical reactions.

The kinetics of reactions of aqueous ozone with inorganic species are of interest for the understanding of a wide variety of systems: ozone interactions in atmospheric cloudwater or urban fog; ozone impinging onto the sea surface; and drinking and cooling water treatment. Second-order rate constants are reported for reactions of ozone with 40 inorganic aqueous solutes. Included are compounds of sulfur (e.g. H2S, H2SO3, HOCH2SO3H), chlorine (e.g. Cl(-), HOCl, NH2Cl, HClO2, ClO2), bromine (e.g. Br(-), HOBr), nitrogen (e.g. NH3, NH2OH, N2O, HNO2) and oxygen (e.g. H2O2), as well as free radicals (e.g. O2(-), OH). Most of these compounds exhibit an increase in rate constant with increasing pH corresponding to their degree of dissociation. Rate constants are based on ozone consumption rates measured by conventional batch-type or continuous-flow methods and determinations of stoichiometric factors. Also listed are data determined by pulse-irradiation techniques using kinetic spectroscopy. Ozone reacts rapidly with many oxidizable inorganic aqueous solutes. Many of them are strongly or fully protected when the site of reaction becomes protonated; most inorganic acids are only reactive in their dissociated form. Ammonia also only reacts when not protonated. Therefore, at pH values below the pKa of the site of the reaction, the rate constants of such solutes generally decrease by a factor of 10 per pH decrement. (Moore-IVI)
W86-01641

222RN CONCENTRATIONS AND VARIATIONS IN UNCONFINED GROUNDWATER,
Kyoto Univ., Osaka (Japan). Research Reactor Inst.
M. Fukui.
Journal of Hydrology, Vol. 79, No. 1/2, p 83-94, July, 1985. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Radon, *Groundwater, *Spatial distribution, Precipitation, Pumping, Geology, Seasonal variation, Sampling, Wells, Japan.

The spatial and vertical distributions of Rn-222 concentration in unconfined groundwater were surveyed, and the change of the concentraiton in groundwater relative to pumping was studied. The daily change of radon concentration in groundwater was observed and the effect of precipitation on the concentration was examined. The surveyed area is located at the Research Reactor Institute of Kyoto University (Japan). Spatial distribution of radon concentrations in groundwater in the limited area of less than 200 sq m showed rather large variation, ranging from about 170 to 300 pCi/l. This may stem from differences in geology, as the boreholes which show the higher concentration of 250-300 pci/l are close to each other. The high values may be due to small differences in the volume of water withdrawn during sampling. Vertical distributions of concentration increase in unconfined groundwater were clearly obtained in summer rather than in winter due to the stability of water density, although the spatial distributions of concentration were observed in a restricted area. The extraction of groundwater leads to about a two-fold increase in the radon concentration compared with the initial value in the borehole. A steady state concentration is reached after the extraction of about 1 cu m of water. Thus it is necessary to pump more than 1 cu m to obtain a representative concentration of the steady state in unconfined shallow groundwater. A decrease in radon concentration caused by dilution by precipitation was observed when the groundwater level rises more than about 50 cm, whereas radon content increased after small rains because the water in the well could exchange with fresh groundwater. The concentration diluted by the precipitation recovers to the former level within a week. (Moore-IVI)
W86-01658

GEOCHEMICAL MASS BALANCE OF A VOLCANIC CRATER LAKE IN AUSTRALIA,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-01663

ALUMINUM MOBILIZATION IN AN ACIDIC HEADWATER STREAM: TEMPORAL VARIATION AND MINERAL DISSOLUTION DISEQUILIBRIA,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5C.
W86-01678

BIOGEOCHEMISTRY OF ALUMINUM IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-01704

MULTIVARIATE ANALYSIS AND INTERPRETATION OF THE HYDROCHEMISTRY OF A DOLOMITIC REEF AQUIFER, NORTHERN ITALY,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2F.
W86-01773

PHOSPHORUS FORMS AND CONTENT IN NATURAL WATER AND FACTORS DETERMINING ITS CYCLING,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
N. G. Dmitrieva, and L. O. Einor.
Water Resources, Vol. 11, No. 4, p 360-370, July-August, 1984. 80 Ref. Translated from Vodnye Resursy, No. 4, p 110-120, July-August, 1984.

Descriptors: *Phosphous, *Natural waters, *Cycling nutrients, Lakes, Rivers, Runoff, Precipitation, Bottom sediments, Water analysis, Organic compounds, Aquatic life.

The formation of the quality of natural water in many respects is determined by the characteristics of hydrochemical and biochemical processes which depend on the effect of a number of factors within and outside of water bodies. The main pools of phosphorus compounds are the water itself, bottom sediments, and biota. The sources of inflow of phosphorus into water objects are the allochthonous runoff, precipitation, groundwater runoff and other factors. The anthropogenic factors of entry of phosphorus into water bodies and streams has become a powerful factor even increasing in significance. Phosphorus is present in surface waters of continental water bodies primarily in an organic form namely, in the composition of living organisms and in particles of dead material suspended in water or settled on the bottom, and in water in the form of soluble organic matter. Balance calculations of the income and outgo of P in various bodies of water is of great value, especially for predicting their state, but is an extremely difficult scientific problem. For its solution it is necessary to have a sufficiently complete and accurate data bank on all components of the phosphorus balance and their changes during a number of years. The calculations can be made as the final step of a quantitative study of sources of the inflow, accumulations, and removal of all P forms. (Baker-IVI)
W86-01811

DETERMINATION OF ZINC, CADMIUM, LEAD AND COPPER IN PRECIPITATION BY COMPUTERIZED DIFFERENTIAL PULSE VOLTAMMETRY,
Netherlands Energy Research Foundation ECN, Petten.
For primary bibliographic entry see Field 5A.
W86-01846

DETERMINATION OF COMMON ANION CONCENTRATIONS IN SURFACE AND GROUNDWATER SAMPLES BY ELUENT-SUPPRESSED ION CHROMATOGRAPHY,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5A.
W86-01847

GROUND-WATER QUALITY IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. R. Larson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4034, 1984. 71 p, 55 fig, 2 tab, 18 ref.

Descriptors: *Water quality, *Groundwater, *Aquifer, *Dissolved solids, Nitrates, Fluorides, Trace elements, *Wyoming.

This report graphically summarizes ground-water quality from selected chemical-quality data for about 2,300 ground-water sites in Wyoming. Dissolved-solids, nitrate, fluoride, arsenic, barium, cadmium, chromium, lead, mercury, selenium, iron, and manganese concentrations are summarized on a statewide basis. The major chemical-quality problem that limits the use of Wyoming ground-water is excessive dissolved-solids concentrations. The aquifers with the best quality water, based on the lowest median dissolved-solids concentration of water in aquifers with 20 or more sampled sites, are Holocene lacustrine deposits, the upper Testiary Ogallala Formation and Arikaree Formation, and the Mississippian Madison Limestone. The counties with the best quality water, based on the lowest median dissolved-solids concentrations are Teton County and Laramie County. Hot Springs County and Natrona County have the highest median dissolved-solids concentrations. About 3 percent of the nitrate concentrations of ground-water samples exceeded the national primary drinking-water standard of 10 milligrams per liter. Fluoride concentrations exceeded the national primary drinking-water standard in 14 percent of the ground-water samples. Except for selenium, toxic trace elements generally have not been found in concentrations in excess of the drinking-water standards. About 19 percent of the iron and about 30 percent of the manganese concentrations in ground-water samples exceeded the national secondary drinking-water standards. (USGS)
W86-01919

2L. Estuaries

COMPUTER SIMULATIONS OF THE FRASER RIVER PLUME,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
L. Royer, and W. J. Emery.
Journal of Marine Research, Vol. 43, No. 2, p 289-306, May, 1985. 7 Fig, 35 Ref. Canadian Natural Sciences and Engineering Research Council Strategic Grants Program for Oceans grant G0353.

Descriptors: *Computer models, *Plumes, *River mouth, *Fraser River, *Straight of Georgia, *British Columbia, *Salinity, Wind-driven currents, Wind velocity, Tidal effects, Water currents, Stream discharge.

Instruments sampling the engine cooling water on two B.C. ferries were used to monitor the temporal and spatial variations of the Fraser River Plume, in the central Strait of Georgia (British Columbia) for nearly two years. Travelling along two different routes north and south of the river mouth, each ferry provided eight horizontal near-surface salinity transects per day. From each transect, the arithmetic average salinity along the section (denoted southern or northern section average salinity) was extracted, formulated as a time series of hourly or daily values and then compared to equivalent computer simulated series. A numerical model, previously developed to examine the effect of tidal forcing on the plume, was modified to include as inputs the hourly wind and daily discharge data. Average model salinities along the ferry section were computed and compared to the observed ferry data. Good agreement was reached after manipulating the entrainment velocity and the momentum transfer from the wind to the plume. The tides were seen to add a relatively small tidal modulation to the general salinity pattern resulting from the combined effects of wind and discharge. (Author's abstract)
W86-01328

LONG-TERM VARIATION OF MACROBENTHOS IN A MESOHALINE REGION OF CHESAPEAKE BAY,
Martin Marietta Environmental Systems, Columbia, MD.
A. F. Holland.
Estuaries, Vol. 8, No. 2A, p 93-113, June, 1985. 7 Fig, 8 Tab, 50 Ref. Maryland Dept. of Natural Resources, Power Plant Siting Program contract P46-83-02.

Descriptors: *Chesapeake Bay, *Maryland, *Benthos, *Population dynamics, Seasonal variation, Salinity, Estuaries, Marine ecosystems, Water temperature, Dissolved oxygen, Habitats.

The long-term variation of macrobenthos was examined at the Calvert Cliffs (Maryland) region of the Chesapeake Bay. Samples were taken from June 1971 to June 1982. Salinities ranged from 5 to 22 ppt over the 11 year study period. Three distinctive macrobenthic communities, that corresponded to the major sediment types sampled, were found in all years: a nearshore sand community, a transitional muddy-sand community and a deep-water mud community. While the species composition of these communities was similar, relative abundances of component species differed among them. Predictable seasonal cycles accounted for a relatively large (>20%) proportion of the total variation for populations that had one well defined annual recruitment pulse. Predictable seasonal cycles accounted for only a small (<10%) proportion of the variation for species that had recruitment throughout the year or aperiodically. Seasonal cycles did not account for much of the variation for species that had large year to year differences in abundance. Correlations between salinity and year to year abundance patterns were frequently significant but accounted for only small amounts of variation. Correlations between year to year fluctuations in dissolved oxygen concentration and abundances of dominant species were always positive in the deep water mud habitat, where they accounted for relatively large amounts of variation. Correlations between temperature and abundance of a few species were significant, however, these correlations accounted for little of the total abundance variation. Macrobenthic abundances and temperature were more frequently correlated for species living in the deep water mud habitat than in shallow habitats. Differences in summer dissolved oxygen concentration controls year to year variation of macrobenthos in the deep water mud habitat, while salinity controls year to year abundances in shallower habitats. Although significant year to year differences were found in the abundance of dominant species, the rank order of the five most abundant species was not random across years and has remained similar for the study decade. (Baker-IVI)
W86-01330

ABUNDANCE FLUCTUATIONS AMONG BENTHIC INVERTEBRATES IN TWO PACIFIC ESTUARIES,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5C.
W86-01333

LONG-TERM ESTUARINE VARIABILITY AND ASSOCIATION BIOLOGICAL RESPONSE,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint.
Estuaries, Vol. 8, No. 2A, p 158-169, June 1985. 7 Fig, 2 Tab, 35 Ref.

Descriptors: *Corpus Christi Bay, *Texas, *Benthic environment, *Estuaries, Ecosystems, Benthos, Cycling nutrients, Productivity, Rainfall, Salinity.

For the past 11 years, detailed data have been collected on benthic community structure, primary and secondary productivity, and sediment nutrient regeneration which are combined with other information, such as fishery yields, into a reconstructed long term data set for the Corpus Christi Bay area.

In 1979 the lowest salinity recorded was related to a short-term high intensity rainfall. Benthos responded with abundance and biomass levels far greater than any other year. Large increases in shrimp yields were correlated with increased benthic production. Primary, secondary, and tertiary carbon production estimates derived from the reconstructed long-term data base indicated benthos as a major link between primary producers and other consumers. Nutrient recycling was judged to provide more than 90% of the nitrogen needed to support phytoplankton production and was considered a major factor influencing ecosystem function. The matching of biological responses to significant environmental changes in this estuary provided insight into ecosystem function and stressed the importance of short-term variability. While recycling was a major source of nutrients supporting primary production, episodic environmental changes from freshwater input provided a much needed stimulation to productivity. These episodic changes replaced materials lost through recycling and sustained productivity over the long term. (Baker-IVI)
W86-01334

FACTORS INFLUENCING THE SALINITY REGIME OF LAKE PONTCHARTRAIN, LOUSISANA, A SHALLOW COASTAL LAGOON: ANALYSIS OF A LONG-TERM DATA SET,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 6G.
W86-01335

BENTHIC NUTRIENT REMINERALIZATION IN A COASTAL LAGOON ECOSYSTEM,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
B. L. Nowicki, and S. W. Nixon.
Estuaries, Vol. 8, No. 2B, p 182-190, June, 1985. 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Nutrients, *Coastal waters, *Lagoons, *Rhode Island, *Potter Pond, Benthic environment, Mineralization, Ammonia, Nitrates, Phosphates, Sediments, Temperature effects, Light effects.

The results of in situ light and dark chamber measurements of benthic community nutrient flux in Potter Pond, a shallow coastal lagoon on the ocean coast of Rhode Island are presented. The rates of ammonia, nitrate, phosphate and dissolved organic phosphorus exchange between the sediments and the overlying water were measured at different temperatures and light levels, from different sediment types, and were compared to similar measurements reported for the deeper, heterotrophic bottom communities of nearby Narragansett Bay. An attempt was also made to calculate the impact of benthic nutrient remineralization on the water chemistry of the lagoon and the potential contribution of regenerated nutrients to both benthic and pelagic primary production. The release of ammonia from muddy sediments in dark chambers ranged from 20-440 micromol per sq m per hr and increased sharply with increase in temperature. On the sandy tidal flat ammonia release rates were significantly lower and showed no response to increasing temperature from 4 to 23 degrees C. Ammonia release rates in corresponding light chambers were somewhat lower than those in dark chambers, though not statistically different. Nitrate fluxes in both light and dark chambers were an order of magnitude lower than ammonia release rates and were also erratic, showing both net uptake and release, with no apparent correlation with either temperature or light. Fluxes of dissolved inorganic phosphate ranged from a net uptake of -10 to a net release of 50 micromol per sq m per hr in dark chambers and from -7 to 29 micromol per sq m per h in light chambers. Phosphate fluxes over mud-sediment areas rose sharply with temperature, while fluxes from the sandy tidal flat tended to fall below those for mud sediments and showed no consistent response to temperature. The lack of mineralized phosphate in the lagoon is reflected in water column phosphate concentration and water column N/P ratios and suggests that the lagoon may show phosphate limitation rather than the nitrogen limitation commonly associated with marine systems. (Baker-IVI)
W86-01336

EUTROPHICATION AND MANAGEMENT INITIATIVES FOR THE CONTROL OF NUTRIENT INPUTS TO RHODE ISLAND COASTAL LAGOONS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5C.
W86-01337

TIDAL EXCHANGE BETWEEN A COASTAL LAGOON AND OFFSHORE WATERS,
Applied Science Associates, Inc., Wakefield, RI.
T. Isaji, and M. L. Spaulding.
Estuaries, Vol. 8, No. 2B, p 203-216, June, 1985. 11 Fig, 2 Tab, 23 Ref.

Descriptors: *Coastal waters, *Lagoons, *Tidal waters, Rhode Island, Charlestown Lagoon, Block Island Sound, Model studies, Finite element method, Hydrodynamics, Model studies.

The integration of a field observation program and hydrodynamic modeling studies are described. A better understanding of the pond circulation dynamics and exchanges of water with the ocean is derived through this integration. The Charlestown lagoon system, located on the southern coast of Rhode Island, consisting of two major basins, Ninigret Pond and Green Hill Pond, served as the study area. The pond system studied responds to first order in a simple pumping mode with the pond water levels rising and falling uniformly throughout in response to offshore forcing. At the semidiurnal tidal frequencies, where most of the energy is located, the sea level response factor is 0.18 with a high water phase shift of 2.5 hr. As the frequency of the forcing function decreases the response factor increases and the phase shift decreases until at periods greater than 4-5 days the water level variations in side and outside the pond are identical in phase and amplitude. The hydrodynamic model predictions for M2 tidal forcing, using the simple inlet hydraulics method of representing the system, are in good agreement with data and also compare well to measurements derived from lab experiments on a simple ocean-inlet bay system. While the geomagnetic electrokineograph (GEK) data provided reasonable estimates of the tidal currents in the breachway its low frequency response was particularly poor. The primary source of long term signal drift in GEK systems is that caused by variation of electrode temperature. A second significant drift source is the random variations which occur in the basic electrochemical potentials of the electrodes themselves. A third source is the telluric potentials which occur at both low and high frequencies. In extreme situations, continuous conductivity monitoring may be required. (Baker-IVI)
W86-01338

VARIABILITY OF DISSOLVED REACTIVE PHOSPHATE FLUX RATES IN NEARSHORE ESTUARINE SEDIMENTS: EFFECTS OF GROUNDWATER FLOW,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
C. F. Zimmermann, J. R. Montgomery, and P. R. Carlson.
Estuaries, Vol. 8, No. 2B, 228-236, June, 1985. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Estuarine environment, *Sediments, *Groundwater movement, *Phosphates, Seagrass, Seepage, Interstitial water, Tidal effects, Indian River, Florida.

Factors influencing the spatial and short term temporal variability inherent in seepage meter measurements and how these measurements relate to variations of selected pore water nutrient concentrations were investigated using the Indian River, a narrow estuarine lagoonal system extending approximately 182 km along the east coast of Florida as the study site. How much of the total flux for dissolved reactive phosphate can be attributed to seepage in nearshore estuarine sediments was determined. The extent of short term dilution effects on sediment pore water was measured. In situ samplers and seepage meters located in the grass beds yielded results very different from the control sampler and meter in the nongrass area of the study site. The variation in seepage velocities and DRP flux rates within a small area of nearshore sediment was closely linked with the heterogeneity of the system. Sediment size analysis of cores collected adjacent to the in situ samplers in the seagrass bed indicated the highest percentage of particles to be in the 150 micro-m range. A higher percentage of these particles was present in the area with no seagrass. The study indicates that the continual movement of groundwater from the sediments of nearshore estuarine areas and the inherent variability of the system is an extremely important factor when considering the total flux of nutrients in a specific area. The effect of the tide, in this case, was to alter the hydraulic gradient. The relationship between groundwater seepage velocity and dissolved reactive phosphate flux in nearshore sediments and its dependence on hydrogeological variables is important in determining nutrient flux budgets. The apparent relationship between tidal height and seepage velocities needs more careful examination and may be even more dramatic in areas with greater tidal ranges. (Baker-IVI)
W86-01339

IMPACT OF DISCHARGES FROM SEAFOOD PROCESSING ON SOUTHEASTERN ESTUARIES,
Georgia Univ., Brunswick. Marine Extension Service.
For primary bibliographic entry see Field 5C.
W86-01340

NUTRIENT ENRICHMENT OF ESTUARINE SUBMERSED VASCULAR PLANT COMMUNITIES. 1. ALGAL GROWTH AND EFFECTS ON PRODUCTION OF PLANTS AND ASSOCIATED COMMUNITIES,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
R. R. Twilley, W. M. Kemp, K. W. Staver, J. C. Stevenson, and W. R. Boynton.
Marine Ecology - Progress Series, Vol. 23, p 179-191, 1985. 8 Fig, 3 Tab, 62 Ref. EPA grants R805932020 and X003248010.

Descriptors: *Nutrients, *Estuarine environment, *Ponds, *Algal growth, Fertilization, Water pollution effects, Aquatic plants, Macrophytes, Solar radiation, Phytoplankton, Epiphytes.

Large experimental estuarine ponds were used to investigate the effects of nutrients on submersed vascular plant communities. The possibility that the decline in these plant communities as a result of fertilization can be explained in terms of increases in epiphytic algal and planktonic biomass which decrease the available light to leaves for macrophyte productivity was investigated. Seston and phytoplankton chlorophyll a increased with fertilization, and pronounced algal blooms were evident under high dosage. Of the total seston, phytoplankton exerted the greatest influence on attenuation of photosynthetically active radiation, such that there was insufficient light for submersed vascular plant growth at the sediment surface during blooms. An extensive epiphytic community developed on plants in all nutrient treated ponds at densities similar to those observed in nature on senescent plants. At high nutrient treatments the accumulation of epiphytic material resulted in over 80% attenuation of the incident radiation at the leaf surface. Biomass of submersed macrophytes decreased significantly under high and medium nutrient treatments compared to control and low treatments within 60 days following initial fertilization. Apparent production of vascular plants was reduced at the higher nutrient treatments. Most of this reduction was explained by attenuation of PAR associated with epiphytic material. Without PAR attenuance in the overlying water, observed levels of epiphytic growth would be insufficient to reduce light below compensation levels needed to

sustain vascular plant growth. At the high fertilization rates, integrated primary production of pond communities was significantly reduced with the loss of the vascular plants, even though phytoplankton and epiphytic growth were enhanced. (Baker-IVI)
W86-01351

PARTITIONING AND TRANSPORT OF METALS ACROSS THE O2/H2S INTERFACE IN A PERMANENTLY ANOXIC BASIN: FRAMVAREN FJORD, NORWAY,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W86-01396

EFFECTS OF PH AND PLANT SOURCE ON LIGNOCELLULOSE BIODEGRADATION RATES IN TWO WETLAND ECOSYSTEMS, THE OKEFENOKEE SWAMP AND A GEORGIA SALT MARSH,
Georgia Univ., Athens. Dept. of Microbiology.
R. Benner, M. A. Moran, and R. E. Hodson.
Limnology and Oceanography, Vol. 30, No. 3, p 489-499, May, 1985. 4 Fig, 33 Ref. NSF grants OCE81-17834, BSR 81-14823, BSR 82-15587 and NOAA, Office of Sea Grant grant NA 80AA-D00091.

Descriptors: *Georgia, *Okefenokee Swamp, *Sapelo Island, *Salt marshes, *Wetlands, *Hydrogen ion concentration, *Lignocellulose, *Biodegradation, Lignin, Isotope studies, Sediments, Microorganisms.

The microbial mineralization of synthetic C-14 labeled lignin, specifically radiolabeled (C-14 lignin)-lignocellulose and (C-14 polysaccharide)-lignocellulose from a variety of aquatic herbaceous and woody plants was investigated in water and sediment from a salt marsh on Sapelo Island, Georgia, and from the Okefenokee Swamp, an acidic peat-forming freshwater swamp in southern Georgia. Rates of microbial degradation of lignocellulose were depressed in the Okefenokee relative to those in the salt marsh. About 50% of the difference in mineralization rates was attributable to the low ambient pH (3.9) of Okefenokee water relative to the pH of salt marsh water (pH 7.1). Rates of mineralization of the lignin component of lignocellulose were only minimally affected within the range of pH 4-8, whereas mineralization of the polysaccharide component increased severalfold with increasing pH. Differences in the biodegradability of the various lignocelluloses were also observed; lignocelluloses from herbaceous plants were mineralized several times faster than lignocellulose from wood. (Author's abstract)
W86-01413

NITROGENOUS NUTRIENT UPTAKE, PRIMARY PRODUCTION, AND SPECIES COMPOSITION OF PHYTOPLANKTON IN THE CARMANS RIVER ESTUARY, LONG ISLAND, NEW YORK,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
E. J. Carpenter, and S. Dunham.
Limnology and Oceanography, Vol. 30, No. 3, p 513-526, May, 1985. 16 Fig, 3 Tab, 26 Ref. NOAA Office of Marine Pollution Assessment grant NA 80-RAD0062, and NSF grant OCE 82-14764.

Descriptors: *Nitrogen, *Nutrients, *Primary production, *Species composition, *Phytoplankton, *Carmans River Estuary, *Long Island, *New York, *Estuarine environment, Ammonium, Nitrates, Urea, Cycling nutrients, Seasonal variation.

Uptake of NH4(+), NO3(-), and urea was measured at four stations in a small temperate-zone estuary over a 10-month period. Considering all four stations, NO3(-) accounted for 45% of all N taken up, followed by NH4(+) (43%) and urea (12%). Nitrogen uptake was highly temperature-dependent (r = 0.82), and an exponential relationship was apparent. Recycling was very important as a source of nitrogen, and mean NH4(+) pool turnover times were rapid, ranging from 4.3 to 6.8 h in the lower estuary in summer. PN turnover times in the lower estuary were also rapid, averaging 28.8 h in summer and being as short as 3.1 h in July and August. An analysis of N uptake using the relative preference index (RPI) indicated that NH4(+) was the preferred nutrient. However, high NO3(-) concentrations appeared to override the repressive effect of NH4(+) concentrations on nitrate reductase, and NO3(-)uptake was significant even at relatively high NH4(+) concentrations. Urea uptake did not appear to be affected by NH4(+) concentration. (Author's abstract)
W86-01415

DISTRIBUTION AND CHARACTERISTICS OF CARBOXYPEPTIDASE ACTIVITY IN POND, RIVER, AND SEAWATERS, IN THE VICINITY OF TOKYO,
Tokyo Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-01418

DEGRADATION AND MINERALIZATION OF THE POLYCYCLIC AROMATIC HYDROCARBONS ANTHRACENE AND NAPHTHALENE IN INTERTIDAL MARINE SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W86-01481

DISTRIBUTION, ABUNDANCE, AND GROWTH OF JUVENILE DUNGENESS CRABS, CANCER MAGISTER, IN GRAYS HARBOR ESTUARY, WASHINGTON,
Washington Univ., Seattle. School of Fisheries.
B. G. Stevens, and D. A. Armstrong.
Fishery Bulletin, Vol. 82, No. 3, p 469-483, July, 1984. 9 Fig, 6 Tab, 23 Ref. Army Corps of Engineers contracts DACW-67-80-C-0086 and DACW-67-81-M-1096.

Descriptors: *Crabs, *Distribution, *Grays Harbor Estuary, *Washington, Immature growth stages, Migration, Habitats, Estuaries, Growth, Seasonal variation.

Dungeness crabs, Cancer magister, were collected biweekly or monthly from May 1980 to July 1981 in Grays Harbor, Washington. Age of each crab was estimated from width-frequency analyses, and the population density and growth rate were monitored for each age class over the 14-month period. In April 1980 and 1981, crabs entered the estuary either as megalops larvae that metamorphosed to first instar postlarvae or directly as first instars. Intertidal mudflats with beds of eelgrass (Zostera spp.) were important habitats for the first few postlarval stages. Some crabs may have emigrated from the estuary during their second year of life, whereas others dispersed throughout the estuary and appeared to emigrate at sexual maturity (about 2 years). No gravid females were ever found in the bay. Population size was estimated to range from 3.3 million crabs (winter) to 39.0 million crabs (summer); 74% of the summer population were early instars. Growth of early instars was rapid and resulted in a 282-fold increase in dry weight from May to September, but little growth occurred during the remainder of the year. Based on summer population abundance, it is estimated that this estuary could account for a substantial portion of recruitment to the offshore commercial fisheries. (Author's abstract)
W86-01496

MICROBIAL DEGRADATION OF THE LEACHABLE AND LIGNOCELLULOSIC COMPONENTS OF LEAVES AND WOOD FROM RHIZOPHORA MANGLE IN A TROPICAL MANGROVE SWAMP,
Georgia Univ., Athens. Dept. of Microbiology.
R. Benner, and R. E. Hodson.
Marine Ecology - Progress Series, Vol. 23, p 221-230, 1985. 6 Fig, 2 Tab, 28 Ref. NSF grant OCE-81117834 and Department of Commerce grant NA 80AA-D-00091.

Descriptors: *Mangroves, *Leaves, *Wood, *Microbial degradation, *Lignocellulose, Swamps, Tropical areas, Carbon radioisotopes, Mineralization, Leachability, Polysaccharides, Detritus, Sediments, Biodegradation.

Preparations of uniformly C-14 labeled mangrove leaves and specifically radiolabeled (C-14 lignin) lignocelluloses and (C-14 polysaccharide) lignocelluloses from mangrove leaves and wood were used in experiments to determine the microbial rates of mineralization of the leachable and lignocellulosic components of mangrove detritus in aerobic and anaerobic sediments of a tropical mangrove swamp. The bulk of the leachable fraction from mangrove leaves was mineralized relatively rapidly and was assimilated into microbial biomass with high efficiency (30%). In contrasts, rates of mineralization of the lignocellulosic component of mangrove leaves and wood were 10-fold lower than mineralization rates or the leachable fraction. The polysaccharide component of the lignocelluloses was mineralized at rates 2 times higher than rates of mineralization of the lignin component, indicating that mangrove detritus becomes relatively enriched in lignin-derived carbon with time. Anaerobic rates of mineralization of the leachable and lignocellulosic components of mangrove leaves and wood were 10 to 30 times lower than respective aerobic mineralization rates, suggesting a very long residence time for mangrove detritus in anaerobic sediments. Comparison of the rates of degradation of mangrove detritus in sediments from a mangrove swamp and a salt marsh demonstrated that the lignocellulolytic potential in sediments of the two marine ecosystems are similar, but that lignocellulose from mangroves is less biodegradable than lignocellulose from the salt-marsh plants, Spartina alterniflora and Juncus roemerianus. (Author's abstract)
W86-01503

SETTING OF THE AMERICAN OYSTER CRASSOSTREA VIRGINICA IN THE JAMES RIVER, VIRGINIA, USA: TEMPORAL AND SPATIAL DISTRIBUTION,
Virginia Inst. of Marine Science, Gloucester Point.
D. S. Haven, and L. W. Fritz.
Marine Biology, Vol. 86, p 271-282, 1985. 7 Fig, 5 Tab, 33 Ref.

Descriptors: *Oysters, *Spatfall, *Temporal distribution, *Spatial distribution, *James River, *Virginia, Larvae, Estuarine environment, Water circulation, Salinity, Stratification, Population dynamics.

Setting of larvae of the oyster Crassostrea virginica was monitored in the James River, Virginia from 1963 to 1980. Setting patterns were similar in two ways to those described prior to 1960 (before the onset of the oyster pathogen Haplosporidium nelsoni (MSX) in Chesapeake Bay): (1) setting intensity (average number of spat per shell) was greater at stations in the lower than upper estuary, and (2) on the average, 60 to 80% of the total annual set at each station occurred during a 6-week period from mid-August through September. However, annual setting intensity from 1963-1980 was lower than previously recorded, and annual sets occurred as a series of discrete pulses rather than continuously throughout the season. Pulses were each approximately 1 to 2 weeks in duration and separated by a period of diminished or no setting. Cross-correlation analysis of annual setting patterns among stations revealed three zones in the James River: the upper estuary and entire southwest side, the lower estuary, and a mid-estuary transition zone. Setting pulses tended to be synchronous at stations within each zone, but occurred 1 to 2 weeks later at stations in downriver than in upriver zones. The location of zones is related to known aspects of water circulation in the James River estuary. Moreover, pulse setting itself may be related to the absence of strong vertical salinity gradients accompanying the fortnightly stratification-destratification process. (Author's abstract)
W86-01504

WATER QUALITY IN AN ESTUARINE ENVIRONMENT: ANNUAL CYCLE OF THE PHYSI-

CAL AND CHEMICAL PARAMETERS OF THE WATER OF THE LOIRE ESTUARY (QUALITE DES EAUX EN MILIEU ESTUARIEN: SUIVI ANNUEL DE CRITERES PHYSIQUES ET CHIMIQUES DANS LES EAUX DE L'ESTUAIRE DE LA LOIRE),
Nantes Univ. (France). Lab. de Biologie Marine.
Y. Rince, J.-F. Guillaud, and B. Gallenne.
Hydrobiologia, Vol. 124, No. 3, p 199-210, May, 1985. 11 Fig, 2 Tab, 30 Ref.

Descriptors: *Estuarine environment, *Water quality, *Loire estuary, *France, River flow, Chemical composition, Nutrients, Dissolved oxygen, Suspended solids, Turbidity, Nitrogen, Phosphorus, Silica.

Chemical composition and physical parameters of waters from the Loire estuary were examined in 1981-1982 in order to assess water quality. It appears that riverflow is of first importance on suspended matter load, dissolved nutrient concentrations and oxygenation. The annual hydrological cycle is made of two periods. During the first one low riverflow, low nutrient concentrations, high suspended matter load and oxygen depletion are noticed. During the second one higher riverflows occur accompanied with increasing nutrient concentrations, decreasing turbidity and restoration of dissolved oxygen. Results indicate that annual inputs of dissolved nutrients attain 60 000 t/a for nitrogen, 2 400 t/a for for phosphorus and 100 000 t/a for silica. It is suggested that the high suspended matter loading (1 million t/a) is a significant factor disturbing oxygenation and by the way limiting water quality within the estuary. (Author's abstract)
W86-01505

ZOOPLANKTON ABUNDANCE DISTRIBUTION, OF A MEDITERRANEAN LAGOON ECOSYSTEM: THE SARRAZINE LAGOON (DISTRIBUTIONS D'ABONDANCES DU ZOOPLANCTON D'UN ECOSYSTEME LAGUNAIRE MEDITERRANEEN: LA LAGUNE DE LA SARRAZINE),
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
T. L. Hoai, M. Amanieu, and G. Lasserre.
Acta Ecologica, Vol. 5, No. 3, p 301-315, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Lagoons, *Zooplankton, *Abundance distribution, Mediterranean, Ecosystems, Model studies, Coastal lagoons, Distribution.

A survey of zooplankton abundance distributions has been carried out from October 1980 to October 1981 in a lagoon artificially managed for aquaculture on the north-western Mediterranean coast. The water body, supplied with sea-water by pump, is considered as an open ecosystem. This is particularly shown by population profiles close to the ones proposed by the Preston and Mandelbrot models of abundance distribution. The Motomura model prevails whenever the lagoon environment is being subject to more severe conditions or the confinement from the near-by sea is intensifying. The parameters of the models of abundance distribution quoted above have been studied as synthetic descriptors of the organization of existing communities. (Author's abstract)
W86-01511

NOTE ON THE DETERMINATION OF VERTICAL TURBULENT TRANSPORT COEFFICIENTS IN A PARTIALLY MIXED ESTUARY,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, D. W. Knight, and K. Shiono.
Proceedings of the Institution of Civil Engineers, Vol. 79, p 235-246, June, 1985. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Turbulence, *Estuaries, Velocity, Salinity, Mixing, Mathematical equations, Vertical transport, Great Ouse estuary, England.

Turbulence measurements of two components of velocity and of salinity have been made in the Great Ouse estuary (England) for partially mixed conditions. The data have been used to investigate the dependence on Richardson number of several coefficients associated with the turbulence closure problem. Empirical equations are presented for the variation of the mixing lengths for momentum and solute with Richardson number for the observed conditions. A limited number of evaluations of the turbulence coefficients associated with the flux terms uw (mean) and sw (mean) gave values which were of the same order as those assumed by other workers for neutrally stable conditions. The field measurement techniques have been shown to be feasible and to yield useful results. More measurements are required over a wider range of conditions in order to substantiate these preliminary findings. (Author's abstract)
W86-01517

DISTRIBUTION AND FLUX OF 226RA AND 228RA IN THE AMAZON RIVER ESTUARY,
Princeton Univ., NJ. Geophysical Fluid Dynamics Program.
R. M. Key, R. F. Stallard, W. S. Moore, and J. L. Sarmiento.
Journal of Geophysical Research, Vol. 90, No. C4, p 6995-7004, July, 1985. 6 Fig, 5 Tab, 32 Ref.

Descriptors: *Radium radioisotopes, *Isotope studies, *Amazon River estuary, *Estuarine environment, Suspended particulates, Mixing, Sediments, Geochemistry, Water chemistry.

Measurements of Ra-226 and Ra-228 in the Amazon River estuary show that desorption from river-borne suspended particulate matter in the estuary increases the riverine flux of both isotopes to the ocean by a factor of approximately 5 over the flux attributable to radium dissolved in the river water alone. The total Amazon flux supplies approximately 0.20% of the Ra-226 and approximately 2.6% of the Ra-228 standing crops in the near-surface Atlantic (0-200 m). Diffusive flux from estuarine and shelf sediments and desorption from resuspended sediments in the region of the estuary approximately double the estuarine Ra-226 concentration and quadruple the estuarine Ra-228 concentration above that caused by the dissolved and desorbed river components alone. (Author's abstract)
W86-01535

EXCHANGE OF WATER IN FJORDS: THE EFFLUX/REFLUX THEORY OF ADVECTIVE REACHES SEPARATED BY MIXING ZONES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. D. Cokelet, and R. J. Stewart.
Journal of Geophysical Research, Vol. 90, No. C4, p 7287-7306, July, 1985. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Fjords, *Mixing, *Advection, Stratification, Salinity, Saline-freshwater interface, Coastal waters, Path of pollutants.

Many fjords consist of deep, stratified reaches separated by shallower sills above which most of the mixing between water masses occurs. On a long time scale, each reach can be modeled as a steady, two-layer advective flow. These flows intermingle in turbulent mixing zones, where the flow from any incoming layer can be split into two parts: an efflux fraction, which continues on into the next reach, and a reflux fraction, which mixes vertically and recirculates into its original reach. These fractions were defined using conservation of mass, and expressed in terms of the salinities observed in the reaches. The processes of the complex mixing zones need not be considered in detail. These ideas are applicable to complicated branched fjords and linked sequences of reaches. Where more than two reaches meet at a multiple junction the conservation of two tracers (usually fresh water and salt) is insufficient to determine completely the efflux/reflux fractions. We propose an entropy maximization technique to resolve the uncertainty. Long-term pollutant concentrations relate directly to the circulation via the new efflux/reflux formulation. The method demonstrates that refluxing leads to conservative pollutants being broadcast throughout the fjord system with magnified concentrations. A new quantity, the mean tracer age, provides a relevant time scale that includes the effects of recirculation and to which the rates of nonconservative processes should be compared. Conservative pollutants may be retained for a surprisingly long time in a refluxing system. (Author's abstract)
W86-01536

SEDIMENT ACCUMULATION RATES IN IRONDEQUOIT BAY, NEW YORK BASED ON LEAD-210 AND CESIUM-137 GEOCHRONOLOGY,
Geological Survey, San Diego, CA. Water Resources Div.
R. A. Schroeder.
Northeastern Environmental Science, Vol. 4, No. 1, p 23-29, 1985. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Sedimentation, *Irondequoit Bay, *New York, *Lead radioisotopes, *Cesium radioisotopes, Stratigraphy, Particle size, Erosion, Copper, Zinc, Metals, Estuarine environment.

Recent sediment accumulation rates in Irondequoit Bay, determined by the lead-210 and cesium-137 techniques, range from 0.10 to 0.36 grams per square centimeter per year. The lowest rate is in Ides Cove, a small inlet on the west side of the bay. On the basis of these rates, it is presumed that sediment below a depth of about 1 meter was deposited before European colonization of the basin in the early 1800's. Average flux of lead-210 in the core from Ides Cove, calculated from lead-210 inventories in the core, equals the published atmospheric deposition rate (from measurements in New Haven, Connecticut); but, the average flux of lead-210 is two to three times higher in the cores from the central parts of Irondequoit Bay. The higher flux is most likely caused by preferential scavenging (sediment focusing) on fine-grained sediments. However, direct input of lead-210 attached to eroding material in the watershed is possible. Concentrations of lead, copper and zinc in the sediments show a marked increase beginning about 50 years ago. As in many other areas, this increase is most likely caused by human activities. The increment over natural background levels is a factor of about 14 for lead, 5 for copper, and 4 for zinc. These ratios are much larger than in many water bodies because urbanization covers a comparatively large proportion of this watershed. (Author's abstract)
W86-01566

METHOD FOR MEASURING HORIZONTAL TRANSPORT OF ORGANIC CARBON OVER SEDIMENTS,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W86-01590

SHORT-TERM ENDPRODUCTS OF SULFATE REDUCTION IN A SALT MARSH: FORMATION OF ACID VOLATILE SULFIDES, ELEMENTAL SULFUR, AND PYRITE,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
G. M. King, B. L. Howes, and J. W. H. Dacey.
Geochimica et Cosmochimica Acta, Vol. 49, No. 7, p 1561-1566, July, 1985. 4 Fig, 1 Tab, 39 Ref.

Descriptors: *Sulfate reduction, *Salt marshes, Sulfides, Sulfur, Pyrite, Oxygen, Carbon dioxide, Metabolism, Marshes, Dissolved solids, Volatile compounds, Wetlands.

Rates of sulfate reduction, oxygen uptake and carbon dioxide production in sediments from a short Spartina alterniflora zone of Great Sippewissett Marsh were measured simultaneously during late summer. Surface sediments (0-2 cm) were dominated by aerobic metabolism which accounted for about 45% of the total carbon dioxide production over 0-15 cm. Rates of sulfate reduction agreed well with rates of total carbon dioxide production below 2 cm depth indicating that sulfate reduction was the primary pathway for subsurface carbon metabolism. Sulfate reduction rates

were determined using a radiotracer technique coupled with a chromous chloride digestion and carbon disulfide extraction of the sediment to determine the extent of formation of radiolabelled elemental sulfur and pyrite during short-term (48 hr) incubations. In the surface 10 cm of the marsh sediments investigated, about 50% of the reduced radiosulfur was recovered as dissolved or acid volatile sulfides, 37% as carbon disulfide extractable sulfur, and only about 13% was recovered in a fraction operationally defined as pyrite. Correlations between the extent of sulfate depletion in the marsh sediments and the concentrations of dissolved and acid volatile sulfides supported the results of the radiotracer work. The data suggest that sulfides and elemental sulfur may be major short-term end-products of sulfate reduction in salt marshes. (Author's abstract)
W86-01614

DEVELOPMENT OF A TREED BOG ISLAND IN A MINEROTROPHIC FEN,
Northern Forest Research Centre, Edmonton (Alberta).
S. C. Zoltai, and J. D. Johnson.
Canadian Journal of Botany, Vol. 63, No. 6, p 1076-1085, June, 1985. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Bogs, *Fens, *Alberta, Vegetation, Nutrients, Calcium, Magnesium, Sulfur, Peat, Trophic level, Trees, Wetlands, Ecology.

Bogs are acid and extremely low in mineral nutrients, while fens are less acidic and more nutrient rich. The development of a heavily treed bog island situated in a wooded fen was studied. The study site itself is a treed bog island, about 0.5 ha in size, situated some 150 m from the edge of a large, 1.2 km wide fen complex in Alberta. An oligotrophic peat layer exists over a mineral-enriched base on the treed island, which supports a predominantly bog vegetation. Macrofossils indicate that the central part of the island has supported oligotrophic treed bog vegetation almost since the beginning of its formation. Three volcanic ash layers allow the reconstruction of the position of the wetland surface at different times. The treed island was initiated on a slight rise and it was always slightly higher than the surrounding fen, maintaining oligotrophic conditions above the fen level. On the treed island, the peat above the fen level is low in such nutrients as calcium, magnesium, and sulfur, but below the fen level the chemical characteristics of the peat are similar to those of the fen peat. Plant remains indicate that conditions have been relatively stable both on the treed island and in the fen; the only major change has been caused by the lateral expansion of the treed island. (Moore-IVI)
W86-01630

DISPERSAL PATHWAYS FOR PARTICLE-ASSOCIATED POLLUTANTS,
Exxon Production Research Co., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-01677

INVESTIGATION OF A EUTROPHIC TIDAL BASIN: PART 2 - NUTRIENTS AND ENVIRONMENTAL ASPECTS,
Southern Water Authority, Otterbourne (England). Resources Planning Lab.
For primary bibliographic entry see Field 5C.
W86-01789

SULFIDE CONTROL OF CADMIUM AND COPPER CONCENTRATIONS IN ANAEROBIC ESTUARINE SEDIMENTS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-01800

EFFECT OF SEAWATER MAGNESIUM ON NATURAL FLUORESCENCE DURING ESTUARINE MIXING, AND IMPLICATIONS FOR TRACER APPLICATIONS,
North Carolina Univ. at Wilmington. Div. of Chemistry.
J. D. Willey.
Marine Chemistry, Vol. 15, No. 1, p 19-45, 1984. 10 Fig, 7 Tab, 43 Ref.

Descriptors: *Seawater, *Magnesium, *Fluorescence, *Estuarine environment, *Mixing, *Tracers, Environmental tracers, Humic compounds, Fulvic compounds, Metals, Copper, Iron, Calcium, Salinity.

Natural fluorescence, which is thought to result from low molecular weight humic and fulvic compounds, can be used as a tracer to distinguish between individual river waters. Natural fluorescence exhibits conservative mixing with seawater, except for a slight fluorescence increase which is sometimes observed in the low salinity range (0-5%). This increase is not due to the inner filter effect (internal quenching). Laboratory experiments can reproduce this low-salinity natural fluorescence increase. Of the major seawater ions, only magnesium can cause a similar natural fluorescence increase. Variation in sample pH, ionic strength, or particle content cannot explain the natural fluorescence increase, nor does it appear to be related to the estuarine flocculation of humic material. Addition of seawater magnesium to the fluorescent material with subsequent loss of hydrogen ions could enhance fluorescence by adding crosslinking to the structure. Replacement of a fluorescence-depressing metal like copper or iron by magnesium could also enhance fluorescence, essentially by removing the quenching effect of the metal. Experimental data in this study are consistent with both of these possible mechanisms. Calcium also enhances fluorescence, however the effect of seawater calcium during estuarine mixing is not as apparent as the magnesium effect. The implications of this low-salinity natural fluorescence increase with respect to estuarine and coastal tracer applications depend on whether individual rivers mix in the high or low salinity region of an estuary or coastal area. (Author's abstract)
W86-01801

ORGANIC MATTER IN THE VOLGA DELTA AND DELTA FRONT,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
M. P. Maksimova, and M. P. Metreveli.
Water Resources, Vol. 11, No. 4, p 352-360, July-August, 1984. 1 Fig, 2 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 100-109, July-August, 1984.

Descriptors: *Volga Delta, *USSR, *Organic matter, Estuarine environment, Rivers, Chemical compounds, River flow, Seasonal variation, Deltas, Runoff, Caspian Sea.

The concentration and biochemical composition of organic matter in river waters entering the Volga upper delta, delta front, and North Caspian are not identical. The zonal differences are due to the intensity and direction of a number of in situ processes specific for various delta zones. The degree and character of zonal differences of organic matter vary seasonally and also depend on the hydrologic characteristics of the year. Physical processes of erosion of organic matter from soils are most characteristic for the upper zones of the western and eastern parts of the delta, especially in the flood period. Decompositional processes are most pronounced in the lower reach of the delta as a result of a decrease of current speeds. The maximum concentrations of organic matter in delta waters are characteristics for the summer low-flow period; slightly lower concentrations are observed in the fall and the minimum in the winter. In an annual aspect processes leading to enrichment of waters in organic matter dominate in the aggregate of differently directed physical, chemical, and biological processes occurring in the Volga delta and delta front. However, enrichment of river waters of continental runoff inorganic matter in the delta does not lead to an increase of organic runoff to the North Caspian, since a considerable part of the organic matter is deposited in the lower reach. As a result of transformation in the delta, the organic continental runoff undergoes qualitative changes: the organic matter entering the North Caspian is somewhat richer in the nitrogen component compared with the organic matter of waters entering the upper delta. (Baker-IVI)
W86-01810

LAW OF THE COAST IN A CLAMSHELL; PART X: THE NORTH CAROLINA APPROACH,
California Dept. of Justice, San Francisco. Office of the Attorney General.
P. H. F. Graber.
Shore and Beach, Vol. 51, No. 1, p 18-23, January, 1983. 2 Fig, 76 Ref.

Descriptors: *Coastal waters, *Erosion, *North Carolina, *Legal aspects, Public rights, Water rights, Erosion control, Coastal zone management.

In 1978 the North Carolina Coastal Management Program became the South's first federally approved coastal plan, and in 1981 an extensive Beach Access Program was initiated. The coastal lands of the state may be divided into three categories, uplands, tidelands, and submerged lands. In common with most coastal states, North Carolina has adopted a high water legal boundary between uplands and tidelands. In general the state follows the usual rule that both accretion and erosion cause changes in the upand/tideland boundary. Noth Carolina's Supreme Court was one of the earliest tribunals to articulate what is now termed the public trust doctrine. In 1981 North Carolina's legislators created the Coastal Beach Access Program to acquire, improve and maintain property along the Atlantic Ocean for a system of public access to ocean beaches. In addition to the right to natural accretion private littoral owners in North Carolina enjoy a qualified right of access to the adjoining navigable waters. Leasing and regulation of coastal zone lands and waters are briefly discussed. (Baker-IVI)
W86-01833

BASIC PRINCIPLES OF SEDIMENT BUDGET STUDY IN THE COASTAL ZONE,
Odesskii Gosudarstvennyi Univ. (USSR).
Y. D. Shuisky, and M. L. Schwartz.
Shore and Beach, Vol. 51, No. 1, p 34-40, January, 1983. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Coastal waters, *Sedimentation, Erosion, Beaches, Sediment budget, Mathematical equations, Geomorphology.

Methods are presented which make it possible to calculate a sediment budget for the coastal zone of any body of water. For that purpose the coastal zone should be broken down into elementary subsystems (longshore cells). Then one must calculate the numerical values of those budget elements which are identified when compiling the preliminary list of elements. Following this, corresponding elements from each of the subsystems are summed up: erosional with erosional, biogenous with biogenous, fluvial with fluvial, etc. As a result, numerical values of the budget elements for the coast as a whole can be obtained. At the present day stage of coastal geomorphology, numerical data are not available to construct a budget equation for the entire coast of the world. However, it is now possible to develop such a sediment budget for large regions of the better-studied coastal zones. (Baker-IVI)
W86-01834

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,
Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
For primary bibliographic entry see Field 6G.
W86-01835

LAW OF THE COAST IN A CLAMSHELL; PART XV: THE SOUTH CAROLINA APPROACH,
P. H. F. Graber.
Shore and Beach, Vol. 52, No. 2, p 18-25, April, 1984. 1 Fig, 98 Ref.

Descriptors: *Coastal waters, *Legal aspects, *South Carolina, Public access, Public rights, Environmental protection, Public trust doctrine, Coastal zone management.

The South Carolina Coastal Management Program, based on the state's 1977 Coastal Zone Management Act articulates ambitious goals and objectives for this valuable zone which includes a 1,241 mile shoreline. Traditionally South Carolina law has recognized that the legal boundary between private uplands and adjoining sovereign tidal-flowed lands is subject to fluctuation as a result of accretion and erosion, which is consistent with the usual common-law rule. A provision in the state's coastal management law purports to alter that rule with respect to owernship of accreted land. The public trust doctrine has not been clearly and expansively applied by South Carolina courts, but in many cases the courts have indicated that tidal flowed lands are held in trust for the public. South Carolina has historically not encouraged public access to the seashore, nor have the state's courts bolstered coastal access by invoking such legal doctrines as implied dedication and custom, which have been used by other jurisdictions. Private landowners along South Carolina's coast still enjoy many traditional littoral rights, but some constraints recently have been imposed under the state's coastal management law and program. The coastal management program discourages private upland owners from developing and keeping certain types of impoundments, such as wetland areas diked off from adjacent tidal rivers and estuaries. South Carolina's coastal zone leasing activities are relatively limited when compared with those of other states, although there are a number of oyster cultivation and phosphate mining leases. (Baker-IVI)
W86-01836

COMPREHENSIVE STUDY OF THE COAST OF CALIFORNIA,
Army Engineer District, Los Angeles, CA.
D. Muslin.
Shore and Beach, Vol. 52, No.2, p 31-35, April, 1984. 2 Fig.

Descriptors: *Coastal waters, *California, *Environmental protection, Water management, Planning, Sedimentation, Sediment transport, Wind, River flow, Aerial photography, Precipitation, Waves.

Prediction of future changes, whether natural or human-induced, is the ultimate goal of scientific studies. This prediction capability allows planners and engineers to allocate valuable natural resources, such as scenic coastal bluffs and sandy beaches, to uses and functions which will maximize their benefits to society, and minimize the harmful social and environmental effects of such allocations. Due to the concern in recent years of the sometimes slow, but always consistent erosion of the California coastline, research by public agencies, private industry, research corporations, and educational institutions has intensified. Although these efforts contribute greatly to the planning and engineering efforts of local areas or circumscribed regions, comprehensive planning for coastal reaches has seldom taken place. The effect of a coastal development on the upcoast or downcoast shoreline is seldom realized until that effect becomes a problem. Coastal development pressures will continue into the next century and beyond. The inadequacy of our knowledge of why shorelines shift, why harbors shoal, and when lagoons will breach their barriers to the sea must be acknowledged and the need for a comprehensive, all encompassing coastal processes study must be addressed. The Section 208 authority addresses the need to study floods aggravated by or due to wind or tidal effects. The Plan of Study outlines the tasks to be undertaken so the effects of wind and tidal waves can be understood and thus the potential for economic growth and the preservation of scenic and wildlife resources will not be diminished or lost in the future. (Baker-IVI)
W86-01837

LAW OF THE COAST IN A CLAMSHELL; PART XVI: THE MAINE APPROACH,
P. H. F. Graber.
Shore and Beach, Vol. 52, No. 3, p 17-20, July, 1984. 59 Ref.

Descriptors: *Maine, *Coastal waters, *Legal aspects, Environmental protection, Tidal lands, Public access, Public rights, Public trust doctrine.

As a result of Maine's adherence to the colonial ordinance of 1647, the property boundary between public and private lands within the state's coastal zone is generally the low-water line. The littoral owner of the upland parcel prima facie owns the adjoining tidelands. Maine, like Massachusetts, is among the minority of coastal states in which the low water line generally demarcates public and private ownership in tideflowed lands. Presumably, Maine accepts the traditional common law concepts that property boundaries along the coast change when there is accretion or erosion. Compared with many other coastal states, public access to the shoreline is somewhat restricted in Maine because the vast majority of the tidelands are privately held. Private upland owners in Maine are legally presumed to have the right of access to the ocean along their entire frontage. The director of the state Bureau of Public Lands may lease state-owned tide and submerged lands for statutorily designated purposes, including dredging, filling, or other needs. Submerged lands may be leased for aquaculture or scientific research. A number of statutes regulate activities in the coastal zone. (Baker-IVI)
W86-01838

LAW OF THE COAST IN A CLAMSHELL; PART XVII: THE CONNECTICUT APPROACH,
P. H. F. Graber.
Shore and Beach, Vol. 51, No. 4, p 15-18, October, 1984. 56 Ref.

Descriptors: *Connecticut, *Coastal waters, *Legal aspects, Water management, Environmental protection, Water rights, Public access, Public rights, Public trust doctrine, Planning, Beaches.

Under the Connecticut Coastal Management Program, the state's coastal area stretches seaward to the limit of state jurisdiction in Long Island Sound. The program utilizes a two-tier approach. The first extends only a short distance landward from the shoreline, while the second tier is bounded by the inland limits of 36 coastal municipalities. The high water mark divides the private uplands from the public tidelands. The upland owner is in general entitled to the benefit of gradual accretion to his property. The public trust doctrine has been judicially recognized but apparently not widely applied in Connecticut. Instead, the state has relied on its regulatory authority under the police power to protect public rights. Beaches are a limited resource in Connecticut. Most of the uplands adjoining these beaches are owned by private parties or by beach associations that usually restrict access to the water across their uplands to residents or association members. The right of access to adjoining navigable waters is the fundamental littoral right of upland owners in Connecticut. The state commissioner of agriculture may lease certain areas for the purpose of planting and cultivating shellfish. Although some restrictions on the use of tidal lands and waters had been imposed earlier, Connecticut's most sweeping legislation in this field has occurred during the past quarter century. These regulatory programs reach beyond the control of navigation and encompass environmental and other concerns. (Baker-IVI)
W86-01840

TARAVAL VERTICAL SEA WALL,
San Francisco City, CA.
P. D. Berrigan.
Shore and Beach, Vol. 53, No. 1, p 3-7, January, 1985. 9 Fig, 5 Ref.

Descriptors: *Beaches, *Erosion control, *Seawalls, *California, *San Francisco, Ocean Beach, Erosion, Sediment transport.

There is a serious beach erosion problem at Ocean Beach, San Francisco in the reach between Noriega and Santiago Streets. The problem will not be solved by beach nourishment alone, but can be solved by extending the Taraval Sea Wall to Noriega Street. The Taraval Sea Wall was originally built in 1941 to protect the Great Highway along Ocean Beach. The area is now part of the Golden Gate National Recreation Area, and is also the site of the construction of the Westside Transport, a large sewer for wet weather flow. If the National Park Service will not alter its policy of No Structures on Beaches, it should return to the city the needed strip of duneland which the city donated to the Park Service, in order that the City can have and maintain, at reasonable cost, a proper beach and highway and have control of the area where planting and fences for abatement of blowing sand can be constructed and maintained. (Baker-IVI)
W86-01841

LAW OF THE COAST IN A CLAMSHELL; PART XVIII: THE VIRGINIA APPROACH,
P. H. F. Graber.
Shore and Beach, Vol. 53, No.1, p 8-14, January, 1985. 97 Ref.

Descriptors: *Legal aspects, *Virginia, *Coastal waters, Public access, Public rights, Public trust doctrine, Water mangement, Water resources development.

Along Virginia's Atlantic coast, many stretches of the uplands immediately adjoining the shoreline are publicly owned. Under a Virginia statute enacted in 1819, the titles of private landowners of uplands adjoining tidewater were generally extended down to the low water mark. The low water mark as the principal property boundary separating private and public lands, shifts with gradual, imperceptible accretion and erosion. In Virginia, an argument might be made that a provision of the conservation of natural resources, added to the state Constitution in 1971, would support a broader application of this doctrine by the commonwealth's courts. In the 1982 decision involving Hog Island's beaches and marshes the commons concept was favored as a means of protecting public rights. In addition to enjoying the benefit of accretion to their property, private owners of land adjoining tidal waters in Virginia have a number of other rights. The commonwealth's Marine Resources Commission, subject to statutory limitation, is empowered to lease the beds of certain state-owned waters for the prospecting for and removal of oil, gas and other minerals. Coastal zone lands and waters are regulated under three principal statutory schemes: the subaqueous lands management program, the Wetlands Act and the Coastal Primary Sand Dune Protection Act. (Baker-IVI)
W86-01842

INLETS AND BARRIER BEACH DYNAMICS: A CASE STUDY OF SHINNECOCK INLET, NEW YORK,
Patchogue, New York.
J. Kassner, and J. A. Black.
Shore and Beach, Vol. 51, No. 2, p 22-26, April, 1983. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *New York, *Shinnecock Inlet, *Beach stabilization, Inlets, Stabilization, Erosion control, Beach erosion, Groins, Sediment transport.

The history of Shinnecock Inlet, its role in coastal processes and the consequences of efforts to stabilize it are reviewed. The dredging and stabilization of the inlet at Shinnecock appear to be the major factors involved in the accelerated erosion of the barrier beach to the west of the inlet. This erosion was exacerbated by the construction of the mid-beach groin field and the failure to backfill the groins to maintain the longshore transport of sediment. This flaw in implementation then led to the construction of additional groins to the west which merely displaced the problem further west. Ironically it appears that the entire beach stabilization project, begun in 1965, may have been unnecessary. By that time, Shinnecock Inlet had entered Period IV and sediment was being naturally by-

passed to the west. The accelerated erosion of the 1950s was therefore significantly reduced. The construction of the groins to address the initial erosion problem caused by the stabilization of the inlet created several others. The history of Shinneock Inlet illustrates the need for comprehensive barrier beach planning and management. Finally, it must be realized that there are no shortcuts in beach stabilization. (Baker-IVI)
W86-01843

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

VISCOELASTIC MODEL FOR INITIAL FLUX DECLINE THROUGH REVERSE OSMOSIS MEMBRANE,
Tohoku Univ., Sendai (Japan). Faculty of Engineering.
Y. Kurokawa, M. Kurashige, and N. Yui.
Desalination, Vol. 52, No. 1, p 9-14, December, 1984. 3 Fig, 10 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Model studies, Flow, Membrane processes, Fluctuations.

Asymmetric cellulose acetate reverse osmosis (RO) membranes exhibit a decline in water flux when operated under RO performance. Especially under the high pressure necessary to desalinate seawater, the membrane creeps and compacts. A homogeneous membrane was prepared from a cellulose acetate butylate (CAB) acetone cast solution. Compression test of the membrane was carried out in such a way that the membrane could be inserted and pressurized mechanically between two cylindrical rods by an electric servohydraulic universal testing machine. RO experiment was performed by using a continuous flow type apparatus. The flux decline through a reverse osmosis membrane is described by assuming that the membrane behaves as a viscoelastic body composed of three elements. This model can be used to predict the flux decline with time for the RO membrane. (Baker-IVI)
W86-01367

EFFECTS OF ACCELERATION ON SPIRAL-WOUND MEMBRANE PERFORMANCE IN REVERSE OSMOSIS,
SRI International, Menlo Park, CA. Engineering Sciences Lab.
J. C. Eid, and G. B. Andeen.
Desalination, Vol. 52, No. 1, p 15-24, December, 1984. 6 Fig, 9 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Buoyance, *Acceleration, Membrane processes, Centrifugation.

Buoyance in reverse osmosis has been considered by several investigators as a means of increasing the flow of contaminants from the membrane surface to reduce fouling and concentration polarization. Buoyance effects arise from the presence of enriched, and thus higher density brine near the membrane, and an acceleration field. An acceleration field placed over a density gradient results in a pressure gradient, which - given proper orientation - leads to a flow. By placing the increasing density gradient in a membrane system in the same direction as the vector of positive acceleration, the flow of contaminants from the membrane surface can be increased. Experimental data show that acceleration, applied to spiral-wound reverse osmosis membranes by centrifugation, increases membrane performance. The effects of acceleration on concentration polarization were determined by testing spiral-wound membranes under accelerations up to 500 x g with 0.5% sodium chloride. The data indicate a reduction in salt concentration at the membrane surface from 2.2 to 1.0% from a nonaccelerated state when 500 x g acceleration is applied to a properly oriented membrane. This reduces the osmotic pressures at the membrane and increases permeate recovery by 21%. (Baker-IVI)
W86-01368

INHIBITION OF CALCIUM SULFATE DEPOSITIONS BY A FLUIDIZED BED,
Akzo Chemie Nederland B.V., Deventer.
J. A. M. Meijer.
Desalination, Vol. 52, No. 1, p 25-42, December, 1984. 15 Fig, 15 Ref.

Descriptors: *Scale, *Fluidized beds, *Desalination, *Calcium sulfate, Seawater, Salts, Temperature effects, Evaporators.

To investigate the influence of the fluidized bed on the deposition of calcium sulfate and to determine the top operational temperature, a test unit with four full-size heat exchanger tubes was built. In these tubes the same mean porosities, the same particles, the same liquid velocities and a comparable heat flux were applied as in an actual multi-stage flash/fluidized bed evaporator design. Since the attention was mainly focused on the formation of calcium sulfate scale in seawater solutions, the experiments were performed with a brine consisting of calcium, sulfate, magnesium, sodium and chloride ions in water in the same ratio as in standard seawater. In these experiments the top temperature was determined as a function of the following parameters: concentration factor of the brine, exclusion or recirculation of seed crystals, degassing or aeration of the brine, and tube diameter and diameter of the fluidized bed glass particles. In addition, the modification of the deposited calcium sulfate crystals forming the scale layer was examined, as well as the habit of the crystals situated either close to the heat transfer surface or at a certain distance from this surface. In all experiments deposition on the tube walls was prevented as long as the hemihydrate solubility line was not exceeded, yielding a practical procedure to assure scale-free operation of a multi-stage flash/fluidized bed evaporator. The scale layers deposited at temperatures above the hemihydrate line consisted initially of stellated conglomerates of hemihydrate crystals, which frequently seemed to be mixed with substantial amounts of gypsum. This initially formed layer was replaced by an anhydrite layer at a rate enhanced by increasing temperatures and decreasing pH values. (Baker-IVI)
W86-01369

FLOCCULATION, PRECIPITATION, SEDIMENTATION AND FLOTATION FOR USE AS PRETREATMENT STAGES FOR BRACKISH WATER AND SEAWATER IN DESALINATION PLANTS,
Hager und Elsaesser G.m.b.H., Stuttgart (Germany, F.R.).
K. Marquardt.
Desalination, Vol. 52, No. 1, p 43-55, December, 1984. 11 Fig, 3 Ref.

Descriptors: *Pretreatment of water, *Desalination, *Flocculation, *Precipitation, *Sedimentation, *Flotation, Water treatment, Water supply development, Brackish water, Seawater.

Groundwater, bank-filtered river water, brackish water and seawater are increasingly being contaminated by high salt contents and organic, colloidal matter. These different types of water can therefore not be fed to a desalination plant without prior pretreatment. Conventional pretreatment methods are characterized by extensive space requirement, excessive building costs and considerable amount of waste water and sludge which is produced. The objectives of this study were to use precipitation and flocculation reactions for removing inorganic and organic matter; to bring about separation of the suspension by using flotation and sedimentation; to apply these processes in compact units to minimize investment costs; and to include sludge treatment in water processing using mechanical techniques of dehydration. (Baker-IVI)
W86-01370

OPTIMIZING DESIGN AND COST OF SEA-WATER REVERSE OSMOSIS SYSTEMS,
DHV Consulting Engineers, Amersfoort (Netherlands).
J. C. Van Dijk, P. J. De Moel, and H. A. Van den Berkmortel.
Desalination, Vol. 52, No. 1, p 57-73, December, 1984. 5 Fig, 7 Tab, 3 Ref.

Descriptors: *Desalination, *Resources development, *Saudi Arabia, *Reverse osmosis, *Seawater, Total dissolved solids, Dissolved solids, Costs, Design criteria.

The influence of design parameters, such as raw water temperature and total dissolved solids content (TDS), design pressure, and recovery, on total unit cost for the production of desalinated water from the Arabian Gulf in Saudi Arabia by means of reverse osmosis is presented for plant capacities ranging from 75,000 cu m/d to 700,000 cu m/d. Total unit water cost is significantly influenced by raw water TDS, design pressure and design recovery. Investigation of the feasibility of operation at increased pressure is recommended. Total costs for reverse osmosis desalination are presented also as a function of salinity, with TDS levels ranging from 3000 mg/l to 55,000 mg/l. (Author's abstract)
W86-01371

REHABILITATION OF AN UNECONOMIC MSF PLANT IN THE CANARY ISLAND, SPAIN,
PRODESA, Las Palmas de Gran Canaria (Spain).
J. Guzman.
Desalination, Vol. 52, No. 1, p 75-85, December, 1984. 5 Fig, 3 Tab.

Descriptors: *Desalination, Fuel, Economic aspects, Evaporators, Spain, Fuerteventura I, Heat recovery.

When the Fuerteventura I plant was installed in 1970 in Spain, the price of fuel was about 15 times lower than it is at present. It is currently prohibitive to run the plant under the same conditions. Rehabilitation of the MSF desalination plant producting 2000 cu m/day is described. Waste heat from diesel engine units in operation nearby has been channeled at a reasonable, economically feasible cost, to the local water authority. These waste gases have an average temperature of 400 degrees C. From the total heat energy of the fuel-oil supplied to a diesel engine only about 40% is converted into mechanical energy; the remaining 60% is wasted mainly in the form of heat as escape gases through the chimneys as well as the water cooling cylinders. The energy loss of the escape gases could even reach 40% of the fuel-oil total heat energy. Three possible means of using these waste gases were explored: conducting the escape gases of the engines to a common collector and installing a single recovery boiler; removing the partial waste heat recovery boiler and providing each diesel engine chimney with a new total waste heat recovery boiler for the full utilization of exhaust gas energy; and eliminating only some of the existing partial waste heat recovery boilers and substituting new ones capable of total utilization of exhaust gas energy. The adopted solution consisted in replacing partial recovery boilers from Diesel chimney Nos. 1, 3 and 5 by total recovery boilers interconnecting chimneys of diesel 1-2 and 4-5 in order to take advantage of the residual energy when twin engines are working at the same time. Thus it makes no difference which engine is working at any one time, since the escape gases could be conveyed indiscriminately to the new total recovery boiler of either group. (Baker-IVI)
W86-01372

DESALINATION PLANTS WITH A CAPACITY OF MORE THAN 95 CU M/D INSTALLED BY JAPANESE MANUFACTURERS (AS OF JANUARY 1, 1984),
Water Re-Use Promotion Center, Tokyo (Japan).
J. Hori.
Desalination, Vol. 52, No. 1, p 87-93, December, 1984. 4 Tab.

Descriptors: *Desalination, Evaporators, Membrane processes, Water management, Japan.

A summary is given of desalination plants installed by Japanese manufacturers in Japan and overseas. The summary is presented in tabular form. Data is divided into the following categories: desalination plants with a capacity of more than 95 cu m/d installed by Japanese manufacturers as of January 1, 1984; desalination plants with a capacity of more than 95 cu m/day installed in overseas countries; process/feed/use breakdown of desalination plants installed in Japan and overseas by Japanese manufacturers in cu m/day. (Baker-IVI)
W86-01373

ECONOMICS OF MSF PLANTS: INFLUENCE OF VARIATIONS IN THE DESIGN PARAMETERS AND USE OF DIFFERENT CONSTRUCTION MATERIALS,
Italimpianti S.p.A., Genoa.
S. Arazzini, R. Borsani, G. Migliorini, and U. Zuboli.
Desalination, Vol. 52, No. 2, p 97-103, May, 1985. 4 Tab, 3 Ref.

Descriptors: *Desalination, *Economic aspects, *Design criteria, *Multistage flash distillation, Drinking water, Capital costs, Construction costs, Evaporators, Water resources development.

Ways in which MSF (multistage flash distillation) can be modified to meet the market demands of reliability and economics are considered. Three aspects are particularly taken into account: comparison between technological features of the long flow against cross flow MSF type, low cost material adoption possibilities, and comparison of process design parameters of the long flow compared with the cross flow MSF type. A substantial reduction of costs (up to 5%) can be obtained adopting a philosophy on material choice and process design criteria which is fully reliable. This aim can be reached through two different steps. First, choice of process parameters to reduce the dimensions of the MSF evaporator. Second, choice of low cost materials to reduce the unit cost of the MSF evaporator. The annual capital cost is thus reduced lowering the initial capital cost and containing the life of the plant within usual terms. The cost of MSF product water is substantially reduced and can be comparable with the cost of water for other desalting processes. (Baker-IVI)
W86-01668

GAS TURBINE WASTE HEAT UTILIZATION FOR DISTILLATION,
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
R. Rautenbach, and B. Arzt.
Desalination, Vol. 52, No. 2, p 105-122, May, 1985. 14 Fig, 5 Tab, 5 Ref.

Descriptors: *Desalination apparatus, *Waste heat, *Gas turbines, Distillation, Multiple effect stack process, Multi-stage flash process, Cost analysis, Seawater, Water resources development.

There are many gas turbines in operation in the Near East and along the North African coast which are suitable for use as a heat source for a desalination unit. The turbines operate in places where fresh water is needed and they are located near the sea. The MES (multiple effect stack) process is found to be superior for this use compared to the standard MSF (multi-stage flash) process. The cost of heating steam from a waste heat boiler is compared with the cost of steam from other sources such as solar energy and fuel-fired boilers. A MES unit will produce much more distillate for comparable investment costs or, the investment costs will be considerably lower in the case of equal distillate production. MES is especially suited for low top-brine temperatures. (Moore-IVI)
W86-01669

MECHANICAL VAPOUR COMPRESSION PROCESS APPLIED TO SEAWATER DESALINATION: A 1,500 TON/DAY UNIT INSTALLED IN THE NUCLEAR POWER PLANT OF FLAMANVILLE, FRANCE,
Societe Internationale de Dessalement, Paris (France).
M. Lucas, and B. Tabourier.
Desalination, Vol. 52, No. 2, p 123-133, May, 1985. 3 Fig, 3 Tab.

Descriptors: *Mechanical vapor compression process, *Desalination, *Seawater, Evaporation, Water quality, Costs, Drinking water, Industrial water, Water resources development.

The largest mechanical vapor compression process unit for seawater desalination in the world is a 1,500 cu m/d unit installed in the Nuclear Power Plant of Flammanville in France which supplies a high quality water to that plant. The process used in this skid-mounted package unit is distillation: spray-film evaporation working at low temperature (60 C) by mechanical vapor compression (13 C) and multistage process (4 effects). Advantages include: high energy savings; reliability; low temperature; compactness of package units which reduces the transportation and erection costs; simple seawater intake without particular pretreatment; seawater flow 2 times the production flow; high purity of distillate from any kind of seawater; easy operation and maintenance. Such units may be used to produce drinkable water or high purity process water for industrial needs. (Moore-IVI)
W86-01670

DEVELOPMENTS IN VERTICAL TUBE EVAPORATION,
Snamprogetti S.p.A., Milan (Italy). Desalination Dept.
M. Bertuzzi, M. Polla, and P. Tiraboschi.
Desalination, Vol. 52, No. 2, p 135-143, May, 1985. 4 Fig, 3 Tab, 3 Ref.

Descriptors: *Desalination, *Water treatment, *Vertical tube evaporation, Thermodynamics, Multistage flash plants, Snamprogetti process, Evaporation, Salinity, Water resources development.

Multiple effect desalination plants using falling film evaporation and vertical arrangement of the effects have proved significantly advantageous thermodynamically because of reduced energy consumption and advantageous due to high operational flexibilty and due to ease of erection in restricted areas. The combination of a vertical tube evaporation (VTE) plant with an existing multi-stage flash plant is presented with a view to improving its efficiency and production. The VTE plant based on Snamprogetti technology has proved highly reliable as demonstrated by the data relevant to the desalination plant at a refinery; the first unit has been running since March 1978 with a capacity of 1440 cu m/day with an 86% stream factor chiefly caused by shutdowns that occurred due to refinery requirements. The second unit, with a capacity of 2400 cu m/day has been running since October 1982 with a 99% stream factor. Additional utilization of VTE could make the multiple effect technology even more competitive. Desalination plants could be run at a high concentration factor (C.F. > 2) and VTE could be combined with existing multi-stage flash (MSF) units. Operation at higher concentration factors is becoming important as the salinity of seawater has steadily increased along the Arabian Gulf due to the presence of numerous desalination plants. A case study demonstrated the advantages offered by a combined plant; in the case of separate plants the output is equal to that of a combined plant, but the performance ratio is far lower and corresponds to the mean of the MSF performance ratio (8.0 lb/kBtu) and the VTE performance ratio (5.1 lb/lBtu), that is 6.5 lb/kBtu, as compared to 12.3 lb/kBtu of the combined plant. The problem of revamping an existing MSF plant according to the flow diagram presented, can be easily solved from a practical viewpoint, because the installation of a VTE column requires a restricted area. (Collier-IVI)
W86-01671

SELECTION OF SMALL DESALINATION PLANTS FOR SPECIFIC LOCATIONS - REVERSE OSMOSIS, FLASH DISTILLATION, VAPOUR COMPRESSION,
Wangnick Consulting Engineers, Gnarrenburg (Germany, F.R.).
K. Wangnick.
Desalination, Vol. 52, No. 2, p 145-165, May, 1985. 29 Fig, 2 Tab.

Descriptors: *Desalination, *Reverse osmosis, *Flash distillation, *Vapor compression, Water treatment, Costs, Economic aspects, Thermodynamics, Decision making, Water resources development.

Selection criteria are given for small desalination plants (2000-3000 cu m/d) for specific locations using reverse osmosis (RO), multistage flash distillation (MSF) or mechanical vapor compression (VC) processes. Of prime economic importance to customers, consultants and manufacturers are peripheral location conditions and operating suitability. Choice by the manufacturers is especially complicated due to the fact that the decision for small plants is left to the bidder. However, based on knowledge of local conditions, manufacturers can anticipate costs. Examples given show that under the assumed conditions the MSF process cannot possibly be the most cost-effective. This applies also to RO when the required product is high-purity process water instead of drinking water. For drinking water any choice between MVC and RO is dependent on energy costs and the capitalization factor. (Author's abstract)
W86-01672

ECONOMICS OF SOLAR STILLS,
3 Plastira Street, Pefki 151-21, Athens (Greece) Tel. 01-8020236.
E. E. Delyannis, and A. Delyannis.
Desalination, Vol. 52, No. 2, p 167-176, May, 1985. 9 Fig, 2 Tab, 13 Ref.

Descriptors: *Desalination, *Economic aspects, *Solar stills, Solar radiation, Energy, Costs, Distillation, Solar distillation, Water treatment, Water resources development.

Since the intensity of solar radiation per unit of evaporating area is determined by nature, the output of a solar distillation unit in a given location can only be increased by increasing the evaporating surface. The productivity of a conventional solar still cannot be more than four to five l/sq m/d for high values of solar radiation. Solar distillation is a free energy operation, however low its efficiency because of low incident radiation. It requires a larger installation area for water production than other conventional desalination processes. Nevertheless it remains the best solution for remote areas and small communities where other water supply systems are not available. Eight solar still designs are illustrated and their physical limitations are discussed. Efficiency of the still plants may be increased by combination with solar collectors, use of available preheated water and by integration with rainwater catchment systems. Solar energy can be converted to thermal, mechanical or electrical energy and then utilized in the solar still process. Solar still efficiency may also be increased by preheating the feed water using condensers inside the solar stills; this method involves additional cost for installation and maintenance and thus may not be justified by the increase in efficiency obtained. It is more economic to install more still units than to attempt to increase the output of a single still by unconventional methods. Distillation with solar energy remains the most favorable process for small capacity water desalting for remote locations where there is considerable solar radiation, but where there are no erection and maintenance facilities or skilled personnel available. In contrast with other desalination processes, in which the cost of energy is very important, if not the major element, solar distillation involves virtually no energy cost. (Collier-IVI)
W86-01673

SEAWATER REVERSE OSMOSIS - AN ECONOMIC ALTERNATIVE TO DISTILLATION,
Du Pont de Nemours International S.A., Geneva (Switzerland).
D. C. Brandt.
Desalination, Vol. 52, No. 2, p 177-186, May, 1985.

5 Fig, 4 Tab, 3 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Distillation, *Multistage flash distillation, Water treatment, Costs, Energy, Environmental effects, Water resources development.

During the last 10 years reversed osmosis (RO) has achieved growing acceptance as an economical and viable alternative to multi-stage flash distillation (MSF) for seawater desalting. The acceptance of this technology is further increasing as a result of plant performance histories and membrane improvements. The abundance of electricity in the Middle East combined with increasing demands for water and restraints on capital spending point to seawater RO as the technology whose time has come. Either alone or in combination with MSF, seawater RO can claim several benefits over MSF: Lower operating costs primarily as the result of energy cost savings. These savings are greater as energy cost increases. Flexibility of operation by the ability to use grid electricity, diversification of plant location and greater load following capability. Replacement of aging MSF plants at minimum capital cost. The ability for power plants to be efficiently designed and operated for power production rather than being controlled by water demands. Combined RO/MSF plants have synergistic benefits through efficiency of plant operation, load following capability, use of excess electricity, product water blending, and lower operating costs than MSF alone. Environmental effects are reduced for a specified quantity of power and water produced due to less fuel burned and warm water discharged to the sea. (Author's abstract)
W86-01674

SEAWATER DESALINATION BY REVERSE OSMOSIS PLANT DESIGN, PERFORMANCE DATA, OPERATION AND MAINTENANCE (TANAJIB, ARABIAN GULF COAST),
Preussag A.G. Bauwesen, Hemmingen (Germany, F.R.). Water Treatment Dept.
W. Heyden.
Desalination, Vol. 52, No. 2, p 187-199, May, 1985. 5 Fig, 5 Tab.

Descriptors: *Desalination, *Reverse osmosis, *Design criteria, *Tanajib, *Saudia Arabia, Water treatment, Seawater, Membrane processes, Water resources development.

A systematic interpretation of critical combinations of feed water, pretreatment and membranes can avoid setbacks in reverse osmosis (RO) processes. RO systems manufacturers will find the right approach if their responsibilities are expanded - beyond just design, construction, installation and commissioning - to an overall responsibility including operation and maintenance. In 1982/83 an oil company ordered a temporary RO seawater desalination plant for Tanajib, on the Arabian Gulf Coast of Saudi Arabia, with a total net capacity of 600,000 gpd. The orders were placed on a turnkey basis including operation and maintenance. The highlights of the RO seawater desalination plant are: shallow beach wells, ultrafiltration, vacuum deaeration, high-pressure multi-stage centrifugal pumps with an energy recovery turbine, single stage reverse osmosis and free programmable logic and process controller. During more than one and a half years of operation, product quantity and quality has always met the design specification. The excellent experience so far with the first temporary Tanajib reverse osmosis seawater desalination plant permit the conclusion that RO technology can avoid setbacks and may face distillation processes competition with confidence. (Author's abstract)
W86-01675

LOW-TEMPERATURE VAPOUR COMPRESSION AND MULTI-EFFECT DISTILLATION OF SEAWATER. EFFECTS OF DESIGN ON OPERATION AND ECONOMICS,
Israel Desalination Engineering Ltd., Tel-Aviv.
R. Matz, and Z. Zimerman.
Desalination, Vol. 52, No. 2, p 201-216, May, 1985. 11 Fig, 3 Tab.

Descriptors: *Distillation, *Vapor compression, *Seawater, *Design criteria, *Economic aspects, Water treatment, Water temperature, Low temperatures, Water resources development.

The design and operating factors are analyzed which lead to the great stability of operation and reliability of low-temperature horizontal tube vapor compression and multi-effect plants. These factors are stated, discussed, and an attempt is made to assess their relative contribution to process economics. Recent reports on the state of the art of desalination technology have indicated the leading position of both low-temperature vapor compression and horizontal tube multi-effect distillation, on technical and economic grounds, for both single- and dual-purpose plants. The practical experience of on-site performance of such has demonstrated the remarkable stability, flexibility and reliability of these processes in comparison with others. The basic concept of low-temperature operation (50-70 C) leads to a chain of interrelated consequences which have a profound effect on the design, economics, operation and maintenance of such plants, some of which can be evaluated in terms of plant and process economics. (Author's abstract)
W86-01676

3B. Water Yield Improvement

AGRICULTURAL BENEFITS FOR SENEGAL RIVER BASIN,
Army Engineer Battalion (79th), APO New York 09360. Company B.
G. L. Hargreaves, G. H. Hargreaves, and J. P. Riley.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 113-124, June, 1985. 4 Tab, 6 Ref, 1 Append.

Descriptors: *Senegal River Basin, *Mauritania, *Mali, *Water resources development, *Agriculture, Economic aspects, Costs, Crops, Computer programs, Irrigation, Water requirements.

A multipurpose water resource development project is proposed for construction and development in the Senegal River Basin. The plans include the irrigation of an area of 274,805 ha by the year 2030 in three countries: Senegal, Mauritania, and Mali. Agricultural benefits were estimated and analyzed by means of a computer program. The factors influencing crop yields were analyzed and summarized including crop selection, water, fertility, and management. Some of the considerations that will produce higher crop yields in future years are presented. It is proposed that the irrigation project management should be responsible for calculating crop water requirements and insuring acceptable irrigation efficiencies. A method is presented for estimating crop water requirements from maximum and minimum air temperatures. The desirability of using irrigation supplemental to rainfall for maximizing benefits from limited water is presented. The maximum contribution of a unit of irrigation water to yield is possible during the rainy season. Projected revenues and costs and years required for each crop to become economically profitable are presented in tables. (Author's abstract)
W86-01432

ECONOMICS OF MSF PLANTS: INFLUENCE OF VARIATIONS IN THE DESIGN PARAMETERS AND USE OF DIFFERENT CONSTRUCTION MATERIALS,
Italimpianti S.p.A., Genoa.
For primary bibliographic entry see Field 3A.
W86-01668

GAS TURBINE WASTE HEAT UTILIZATION FOR DISTILLATION,
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
For primary bibliographic entry see Field 3A.
W86-01669

MECHANICAL VAPOUR COMPRESSION PROCESS APPLIED TO SEAWATER DESALINATION: A 1,500 TON/DAY UNIT INSTALLED IN THE NUCLEAR POWER PLANT OF FLAMANVILLE, FRANCE,
Societe Internationale de Dessalement, Paris (France).
For primary bibliographic entry see Field 3A.
W86-01670

DEVELOPMENTS IN VERTICAL TUBE EVAPORATION,
Snamprogetti S.p.A., Milan (Italy). Desalination Dept.
For primary bibliographic entry see Field 3A.
W86-01671

SELECTION OF SMALL DESALINATION PLANTS FOR SPECIFIC LOCATIONS - REVERSE OSMOSIS, FLASH DISTILLATION, VAPOUR COMPRESSION,
Wangnick Consulting Engineers, Gnarrenburg (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W86-01672

ECONOMICS OF SOLAR STILLS,
3 Plastira Street, Pefki 151-21, Athens (Greece) Tel. 01-8020236.
For primary bibliographic entry see Field 3A.
W86-01673

SEAWATER REVERSE OSMOSIS - AN ECONOMIC ALTERNATIVE TO DISTILLATION,
Du Pont de Nemours International S.A., Geneva (Switzerland).
For primary bibliographic entry see Field 3A.
W86-01674

SEAWATER DESALINATION BY REVERSE OSMOSIS PLANT DESIGN, PERFORMANCE DATA, OPERATION AND MAINTENANCE (TANAJIB, ARABIAN GULF COAST),
Preussag A.G. Bauwesen, Hemmingen (Germany, F.R.). Water Treatment Dept.
For primary bibliographic entry see Field 3A.
W86-01675

LOW-TEMPERATURE VAPOUR COMPRESSION AND MULTI-EFFECT DISTILLATION OF SEAWATER. EFFECTS OF DESIGN ON OPERATION AND ECONOMICS,
Israel Desalination Engineering Ltd., Tel-Aviv.
For primary bibliographic entry see Field 3A.
W86-01676

CURRENT STATUS OF DENVER'S POTABLE WATER REUSE PROJECT,
Denver Water Dept., CO.
W. C. Lauer, S. E. Rogers, and J. M. Ray.
Journal of American Water Works Association, Vol. 77, No. 7, p 52-59, July, 1985. 6 Fig, 7 Tab, 5 Ref. U.S. EPA contract CS-806821.

Descriptors: *Denver, *Colorado, *Water reuse, Water supply development, Water treatment, Municipal water, Potable water, Drinking water.

The feasibility of directly treating processed wastewater plant effluent to potable quality is being tested in Denver, Colo., with a full-scale, 1-mgd (3.8-ML/d) demonstration plant. The complexity of putting the system into operation and the results to date are described, along with an outline of the plans for health effects research, economic studies, and programs to gain public acceptance of direct reuse. This project is expected to provide the information necessary to evaluate the feasibility of direct reuse, especially for cities located in water-scarce areas where development of more conventional water resources is becoming increasingly costly, both in terms of the environment and in capital investments. (Author's abstract)
W86-01742

WATER REUSE IN CALIFORNIA,
California Dept. of Health Services, Berkeley.
J. Crook.
Journal of American Water Works Association, Vol. 77, No. 7, p 60-71, July, 1985. 4 Tab, 43 Ref.

Descriptors: *Water reuse, *California, *Water treatment, *Irrigation practices, Groundwater recharge, Water quality, Public health, Water resources development.

Advances in wastewater treatment technology and reliability allow the safe reuse of effluent for several purposes when reasonable precautions are taken. A 1984 survey in California indicates that approximately 220,000 acre-ft (272 million cu m) of wastewater is reclaimed in the state by 240 wastewater plants that supply reclaimed water to more than 380 use areas. Irrigation accounts for approximately 80% of the total quantity of wastewater reclaimed in the state. Well over half of the reused wastewater in the state is for the irrigation of fodder, fiber, and seed crops and for the surface irrigation of orchards and vineyards - uses that do not require a high degree of wastewater treatment. The Department of Health Services has established statewide wastewater reclamation criteria for various uses, based on the degree of human exposure to pathogens and other contaminants that could be present in treated wastewater. For most uses of reclaimed water, biological agents pose a greater health risk than chemical contaminants and quality standards are properly directed at these agents. The chemical constituents are a major concern when reclaimed water is used for indirect potable reuse via groundwater recharge and could also be a concern when reclaimed water is used for crop irrigation. The degree of contact between irrigation water and the edible tissues of a crop - as influenced by the irrigation method practiced - will modify the type of treatment required for reclaimed water before its agricultural use does not pose a health threat. California regulations specify wastewater reuse standards for irrigation, impoundments and groundwater recharge and include water quality standards, treatment process requirements, sampling and analysis requirements, operational requirements, and treatment reliability requirements. (Collier-IVI)
W86-01743

OBTAINING PUBLIC SUPPORT FOR REUSE WATER,
California Univ., Berkeley. Dept. of Social Administrative Health Services.
W. H. Bruvold.
Journal of American Water Works Association, p 72-77, July, 1985. 4 Tab, 10 Ref.

Descriptors: *Water reuse, *Public opinion, *Surveys, Attitudes, Public relations, Water resource development, Potable water, Irrigation water, Drinking water.

Nine public opinion surveys taken during the past 13 years have shown remarkably similar attitudes towards the use of reclamined wastewater for drinking and nonpotable purposes. The number of respondents who were negative, opposed, or unfavorably disposed toward the concept ranged from 45 to 60% for most studies; six of nine studies showed a majority were opposed to the use of reclaimed wastewater for drinking. Thirty to 50% of the respondents were positive or not opposed, with more favorable results associated with a positive bias in question phrasing. Although people are generally opposed to the use of reclaimed wastewater for drinking, there is a sizable minority who are not opposed, and thus there may be uses of reclaimed wastewater for purposes other than drinking that are much more acceptable to the general public. People having the most favorable attitude toward using reclaimed wastewater for drinking would believe that their water supply was already polluted, that there was a water shortage in their area, that technology for effectively treating wastewater exists, that health risks involved in high-contact uses of reclaimed water are not substantial, that economic benefits would accrue to the community that uses reclaimed water, and that public opinion favors the use of reclaimed water. Older, less well-educated people would have more negative attitudes, not because they are older and less well educated, but because they do not believe in water purification technology and because they do not believe a water supply shortage exists in their community; the opposite would be true of younger, better educated people. The survey research provides a basis for recommending the content of persuasive communications constituting an educational campaign. (Collier-IVI)
W86-01744

3D. Conservation In Domestic and Municipal Use

RECLAIMING DESERT LANDS THROUGH WATER REUSE,
Goff Consulting and Engineering Corp., Chandler, AZ.
For primary bibliographic entry see Field 5D.
W86-01746

CONSERVATION USING A RATE OF RETURN DECISION RULE: SOME EXAMPLES FROM CALIFORNIA MUNICIPAL WATER DEPARTMENTS,
California Univ., Santa Barbara. Dept. of Economics.
L. J. Mercer, and W. D. Morgan.
Water Resources Research, Vol. 21, No. 7, p 927-933, July, 1985. 5 Tab, 9 Ref. Bureau of Reclamation grant 14-34-0001-0477.

Descriptors: *Water conservation, *Rate of return, *Pricing, *California, Municipal water, Utilities, Simulation, Economic aspects.

A significant alternative to physical rationing of water to achieve conservation is provided by the price system. To act like profit maximizing firms, municipal water utilities (MWD's) should price their water so as to earn the opportunity cost of capital (the market rate of return) on the assets. The actual internal rate of return is calculated for a sample of 30 California MWD's for a 12-year period. For the 26 MWD's with a rate of return less than 10%, iterative simulations are run with increases in the MWD's average price to achieve the target rate of return. The magnitude of water conservation using the rate of return rule is reported for three alternative price elasticities of demand. The new implicit prices necessary to achieve the target rate of return are shown to be less than the cost of the cheapest new surface supply. (Author's abstract)
W86-01763

3F. Conservation In Agriculture

SALINE GROUNDWATER MANAGEMENT AND OPTIMAL CROPPING PATTERN,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 4B.
W86-01380

IRRIGATION SCHEDULING USING CROP INDICATORS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 7B.
W86-01433

FURROW IRRIGATION SIMULATION TIME REDUCTION,
California Univ., Davis. Dept. of Agricultural Engineering.
M. Rayej, and W. W. Wallender.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 134-146, June, 1985. 6 Fig, 15 Ref.

Descriptors: *Furrow irrigation, *Irrigation practices, *Computer models, Model studies, Moving boundary method, Infiltration.

Temporal and spatial changes in the flow profile decrease with time under furrow irrigation, and these slow changes suggest modifications in the simulation methods. Geometrically increasing time steps and node deletion at the upstream boundary are introduced and evaluated for accuracy and CPU time reduction. Increasing the time steps reduced CPU time without sacrificing accuracy significantly in predicting advance. The geometric progression factor is estimated automatically from the first two advance increments, thus incorporating site-specific flow and infiltration characteristics. The moving left boundary method is slightly more accurate, but is less cost-efficient than the varying time-step modification for the example conditions. However, special infiltration conditions may favor the latter method. (Author's abstract)
W86-01434

EFFICIENT WATER USE IN RUN-OF-THE-RIVER IRRIGATION,
Central Luzon State Univ., Munoz (Philippines). Dept. of Agricultural Engineering.
H. L. Angeles, and R. W. Hill.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 147-159, June, 1985. 3 Fig, 5 Tab, 10 Ref, 1 Append.

Descriptors: *Irrigation practices, *Water use efficiency, *Philippines, Hydrographs, Model studies, Soybeans, Rice, Drainage, Costs, Seasonal variation.

Irrigation water demand, crop yield and water allocation models were developed and applied to a Philippine run-of-the-river irrigation project. Dry season water supply hydrographs were classified into four levels of availability from high (I) to low (IV). These levels were correlated with the October stream flow volume to provide a prediction of dry season supply. Project net annual benefits could be increased for all four season water supply hydrograph levels by growing an upland crop (soybean) and rice, instead of only rice, providing that costs were less than $90/ha for additional drainage facilities. Net benefits for all rice were greater for reduced area planted, but fully irrigated when the available dry season water supply was lower than average as compared to planting the total area with inadequate irrigation. The irrigation system water demand model was calibrated to match actual diversions for the 1977-78 dry season. The project irrigation efficiency, combined effects of conveyance and application, was determined to be 41%. Thus, a savings in available water supply could be realized by increased system efficiency both from physical modifications as well as from improved management. (Author's abstract)
W86-01435

REUSE SYSTEM DESIGN FOR BORDER IRRIGATION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
M. Yitayew, and D. D. Fangmeier.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 160-174, June, 1985. 4 Fig, 5 Tab, 17 Ref, 1 Append.

Descriptors: *Water reuse, *Border irrigation, *Irrigation practices, Design criteria, Model studies, Runoff.

Significant and rapid improvement in surface irrigation systems is needed to minimize critical water shortages. There is a great potential for improving surface irrigation systems without affecting the farmer's application method; this can be done with reuse systems. The primary purpose of a reuse system is to collect irrigation runoff water and control it for furthur use. The system requires a sump or reservoir to collect and store the water, pump facilities for pumping it back, and a pipeline or canal for conveying water back to the irrigation system. A procedure is presented for designing a system to reuse runoff from free outflow irrigation borders. Runoff volumes are obtained using four dimensionless variables and runoff curves developed with a zero-inertia mathematical model. The equations make use of runoff curves previously developed to give the components of the reuse system, mainly the sump and pump sizes. Use of

the ultimate post irrigation subsurface water profile was made to get the time of runoff without the need for different design curves. An example of the design procedure includes different modes of reuse system operation. (Collier-IVI)
W86-01436

VOLUMETRIC PRICING OF AGRICULTURAL WATER SUPPLIES: A CASE STUDY,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6C.
W86-01766

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SOUTHLAND FLOOD OF JANUARY 1984,
Southland Catchment Board, Invercargill (New Zealand).
For primary bibliographic entry see Field 2E.
W86-01388

IMPACT OF RIVER CHANNELIZATION; II. CHANNELIZATION: SOME ENGINEERING ASPECTS,
North West Water Authority, Warrington (England). Rivers Div.
D. L. Hockin.
Geographical Journal, Vol. 151, No. 1, p 54-57, March, 1985.

Descriptors: *Channeling, *Land development, *Flood control, Environmental effects, Design criteria, Drainage, Hydraulic design.

One reason for channelization is to control urban flooding. Land developers have noticed that the floodplain area along a river frequently offers flat land for easy industrial, residential and recreational development, ignoring the fact that this same land is subject to floods during major storms. Other problems which require attention to proper channelization arise from the need to provide improved drainage of agricultural land, and taking care that mining subsidence does not adversely affect natural drainage. Factors which influence channel design and are considered here include hydraulic parameters, the standard of protection that is adopted, adjoining land use, ground conditions, maintenance requirements for channel works, and environmental and amenity aspects. Two of the most frequent criticisms of the engineer's channelization work are indiscriminate removal of trees and vegetative cover from the banks of watercourses and excessive straightening. (Baker-IVI)
W86-01402

IMPACT OF RIVER CHANNELIZATION; III. DOWNSTREAM MORPHOLOGICAL CONSEQUENCES OF RIVER CHANNELIZATION IN ENGLAND AND WALES,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
A. Brookes.
Geographical Journal, Vol. 151, No. 1, p 57-62, March, 1985. 3 Fig, 11 Ref.

Descriptors: *Channeling, *England, *Wales, *Environmental effects, *Channelization, Water resources development, Land use, Erosion control, Rivers, Construction, Stream morphology.

Recent field investigations of the downstream morphological consequences of river channelization at a total of 57 water authority sites were reviewed. This research indicates that the downstream consequences can be divided into those effects associated with construction, and characterized by the release of excess amounts of sediment, and those which occur during the years following completion of a scheme in response to changes in the frequency and magnitude of discharges. The majority of sites studied in high energy environments in England and Wales underwent some form of erosive adjustment in the downstream reach in the long term and it is proposed that the increased flows generated by each scheme were sufficient to exceed a threshold required for erosion. Channel enlargement varied spatially, declining with distance away from each channelization scheme. A further type of channel change observed was the accentuated erosion of the outside of bends, but without the associated point bar deposition characteristic of natural landform changes. The majority of sites studied in low energy environments in lowland Britain had not undergone downstream channel change. Analyses of the amount of change produces relationships which can be useful in indicating the amount of adjustment likely in specific situations. (Baker-IVI)
W86-01403

IMPACT OF RIVER CHANNELIZATION; IV. THE ECOLOGICAL EFFECTS OF CHANNELIZATION,
Welsh Water Authority, Nelson. South East District.
For primary bibliographic entry see Field 6G.
W86-01404

RIVER RECESSION ANALYSIS IN THE OPERATIONAL MANAGEMENT OF LAKE ABSTRACTION,
For primary bibliographic entry see Field 2E.
W86-01522

4B. Groundwater Management

GROUNDWATER IN WATER RESOURCES PLANNING: CONJUNCTIVE USE,
Universidad Politecnica de Valencia (Spain).
A. Sahuquillo.
Water International, Vol. 10, No. 2, p 57-63, June, 1985. 25 Ref.

Descriptors: *Groundwater, *Water supply development, *Conjunctive use, Planning, Water management, Water storage, Drought, Water supply.

Growing water needs, the constraints caused by water pollution and the cost of water development projects, including the cost of responding to social and environmental concerns, are increasing dramatically. It has become imperative to take into consideration all water sources and facilities in order to satisfy present and future water demands. Although groundwater has very often been overlooked by planning specialists, it can offer technical and economic advantages worthy of consideration. Groundwater can provide additional resources as well as the means for water storage, distribution and treatment, which can be combined advantageously with surface water resources. Likewise, groundwater can provide other advantages such as its adaptability to a progressive increase in the demand for water, the possibility of temporary overexploitation as a means to defer costly construction projects, mitigate the effects of droughts and alleviate drainage problems. (Baker-IVI)
W86-01375

SALINE GROUNDWATER MANAGEMENT AND OPTIMAL CROPPING PATTERN,
Punjab Agricultural Univ., Ludhiana (India).
M. P. Kaushal, S. D. Khepar, and S. N. Panda.
Water International, Vol. 10, No. 2, p 86-91, June, 1985. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Irrigation water, *Groundwater management, *Saline waters, *Cropping patterns, Conjunctive use, Water resources, Water quality, Water supply development, Model studies.

A decision model has been developed for optimal cropping pattern based on both leaching requirements and salinity response functions. This model, a deterministic linear programming model, represents the real world situation prevailing in different regions of the world. The model has been applied to the command area of a minor canal to solve a real world problem. The design discharge of the minor canal is 59 liters/s. The culturable command area is 28 ha. The full supply days in winter season and monsoon season are 131 and 146, respectively. The command area is irrigated by canal and groundwater. In order to find the optimal cropping pattern and optimal canal and saline groundwater mix, the possibility of increasing available water by mixing canal and saline groundwater in suitable proportion was examined. The model effectively adjusted the cropping pattern according to the availability of irrigation water as one would expect in the real world situation. Top priority should be accorded to irrigation extension activities to encourage conjunctive surface water-groundwater use. The optimal mixing of surface water and poor quality groundwater is essential for maximizing the returns and to ensure optimum soil conditions for plant growth. (Baker-IVI)
W86-01380

DIFFERENCES IN ANNUAL EVAPORATION BETWEEN GRAZED PASTURE AND EUCALYPTUS SPECIES IN PLANTATIONS ON A SALINE FARM CATCHMENT,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2D.
W86-01473

GROUNDWATER AT HOME AND ABROAD,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-01524

EFFECT OF INCOMPLETE RECOVERY PRIOR TO A PUMP TEST IN A LARGE-DIAMETER WELL,
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W86-01664

CAN WE SAVE THE OGALLALA,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
R. M. Sweazy.
Civil Engineering, Vol. 55, No. 8, p 36-39, August, 1985. 3 Fig.

Descriptors: *Ogallala Aquifer, *High Plains, *Texas, *Groundwater management, Artificial recharge, Water conservation, Water reuse, Desalination, Weather modification, Aquifers.

Management of the Ogallala aquifer has been widely criticized, but half truths and misinterpretations abound. Water conservation on the High Plains takes many forms. Crops have been genetically manipulated to increase their tolerance to drought. Irrigation practices have been modified on farms, city parks and lawns, moisture detecting devices determine when to irrigate and how much water to apply. Reclaimed municipal waste water has been used for almost 50 years for irrigation and industrial cooling. Surface drainage on the High Plains of Texas tends to be to playa lakes, shallow basins several hundred feet across that occur naturally about one per square mile. A combination of current and future conservation practices, reuse of water, recharge and secondary recovery could well render the Ogallala a quasi-stable aquifer in the next century. All this depends on more research. Areas to be investigated are the cost of desalination, which could provide a valuable source of water supply, and weather modification. (Baker-IVI)
W86-01737

COMPONENTS OF FLOW RESULTING FROM ABSTRACTION IN A TWO-LAYERED CONFINED AQUIFER WITH NO CROSS FLOW,
Institute of Hydrology, Wallingford (England).

For primary bibliographic entry see Field 2F.
W86-01770

4C. Effects On Water Of Man's Non-Water Activities

LONG-TERM STREAMFLOW OBSERVATIONS IN RELATION TO BASIN DEVELOPMENT,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
M. Owe.
Journal of Hydrology, Vol. 78, No. 3/4, p 243-260, June, 1985. 11 Fig, 1 Tab, 29 Ref.

Descriptors: *Streamflow, *Land use, *Watersheds, Forests, Urban areas, Cultivated lands, Grasslands, Suburban areas, Overland flow, Evapotranspiration, Chester Creek basin, Pennsylvania.

Watersheds located in rapidly developing areas undergo complex land-use transitions in relation to the more unidirectional trends generally displayed in more rural areas. The Chester Creek basin, located in southeastern Pennsylvania is representative of developing areas in the Northeast. Streamflow estimated by the Thornthwaite Water Balance Method was used as an unbiased control to demonstrate an increase in actual runoff during the 51-yr. period of record. Relationships between streamflow and the historical trends of five land cover classes, forest, urban, residential, cultivated crop land and open grass were investigated. While urban and residential areas experienced an increase, crop lands steadily decreased. Forested areas initially decreased, then increased, while open areas first increased then decreased rapidly. The net effect on the basin has been an increase in overland flow and a decrease in evapotranspiration. Annual, growing and dormant season streamflow were found to have increased 51, 57 and 46% respectively. Evidence suggests that these increases are the direct result of changes in the surface character of the basin. (Author's abstract)
W86-01472

WATER QUALITY EFFECTS OF PINE FLATWOODS SILVICULTURE,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
H. Riekerk.
Journal of Soil and Water Conservation, Vol. 40, No. 3, p 306-309, May-June, 1985. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Water quality, *Pine trees, *Forest management, Florida, Cutting management, Forest watersheds, Hydrogen ion concentration, Suspended sediments, Calcium, Potassium, Nonpoint pollution sources.

Three watersheds in the poorly drained pine flatwoods region of north central Florida were monitored for 6 years. Three silvicultural treatments were imposed during the second year; harvest with minimum disturbance and site preparation, harvest with maximum disturbance and site preparation, and an undisturbed control. The minimum treatment included manual shortwood harvesting, slash chopping, soil bedding, and machined planting. The maximum treatment included machine tree-length harvesting, slash burning, windrowing, soil bedding, and machine planting. There were small but significant increases in pH, suspended sediment, Ca, and K, proportional to the degree of disturbance during the treatment year. Only K and Ca levels remained significant during the first post-treatment year. Minimum-disturbance practices with protective stream management zones will minimize nonpoint-source pollution. (Author's abstract)
W86-01494

WATERSHED PROTECTION STRATEGIES FOR THE SCITUATE RESERVOIR,
Rhode Island Dept. of Environmental Management, Providence. Office of Environmental Coordination.
L. B. Joubert.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 136-156, June, 1985. 8 Ref.

Descriptors: *Scituate Reservoir, *Rhode Island, *Watershed protection, *Water quality control, Water quality, Drinking water, Water resources development, Non-point pollution sources, Land use, Hazarous materials spills.

The Scituate Reservoir is the sole source of water for the City of Providence and the surrounding metropolitan area. The watershed is predominantly rural in character but it is certainly not isolated. The current study confirmed the excellence of the water quality in the Reservoir. Watershed management and emergency spill response has been effective in maintaining water quality. Contaminants that do find their way into the reservoir from nonpoint sources and spills have been assimilated and diluted within the system with little effect. Future water quality is subject to increasing traffic volumes and growth pressures - factors over which there is presently little control. Objectives of proposed actions are to improve highway safety and drainge, reduce the amount of hazardous materials transported across the watershed, promote more efficient spill response, and control non-point source discharges through land use management. (Baker-IVI)
W86-01752

GLOBAL STATUS AND TREND OF DESERTIFICATION,
United Nations Environment Programme, Nairobi (Kenya). Desertification Branch.
For primary bibliographic entry see Field 2B.
W86-01855

WATER QUALITY OF A SMALL URBAN CATCHMENT NEAR DURBAN, SOUTH AFRICA,
Durban-Westville Univ. (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W86-01861

4D. Watershed Protection

LIMITS ON THE USEFULNESS OF EROSION-HAZARD RATINGS: EXPERIENCES IN NORTHWESTERN CALIFORNIA,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. M. Rice, and P. D. Gradek.
Canadian Journal of Forest Research, Vol. 14, No. 4, p 559-564, August, 1984. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Erosion-hazard ratings, *Logging, *California, Forest management, Soil erosion, Erosion control, Yarding, Prediction.

Although erosion-hazard ratings are often used to guide forest practices, those used in California from 1974-1982 have been inadequate for estimating erosion potential. To improve the erosion-hazard rating procedure, separate estimating equations were used for different situations. The ratings were partitioned according to yarding method, erosional process, and both yarding method and erosional process. Partitioning by yarding method resulted in a slight improvement in the precision of erosion estimates. The other two methods resulted in fourfold increases in prediction errors. Results indicate that a single unified erosion-hazard rating procedure is the most practical way of predicting logging-related erosion in northwestern California. (Author's abstract)
W86-01783

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SPECIES DIVERSITY OF ALGAL FLORA IN VISHWAMITRI RIVER, BARODA (INDIA),
S.S.V.P. Santha's Science Coll., Dhule (India). P.G. Dept. of Botany.
S. N. Nandan, and R. J. Patel.
Polskie Archiwum Hydrobiologii, Vol. 32, No. 1, p 1-6, 1985. 4 Tab, 12 Ref.

Descriptors: *Species diversity, *Algae, *Vishwamitri River, *Baroda, *India, Physico-chemical characteristics, Water pollution, Bioindicators, Indicators, Chemical oxygen demand, Carbonates, Alkalinity, Nitrates, Phosphates, Calcium, Total solids, Water pollution effects.

Shannon's diversity index was studied to analyze the structure of the algal community in the Vishwamitri river flowing through Borada city during December, 1980 to December, 1982. The diversity index was calculated according to Shannon's function. All the three stations selected did not show any difference in the mean values of DI, but the values of each month showed slight variation. The diversity index was correlated with 17 physicochemical parameters. It showed direct relationships with carbonate, total alkalinity, nitrate, phosphate, calcium and total solids whereas it showed inverse relationships with COD at all 3 stations. DI holds promise as an index for determining the degree of pollution. (Author's abstract)
W86-01325

INDICATORY ROLE OF SOME INVERTEBRATES FOR QUALITY OF WATER IN THE VISTULA RIVER AND IN SUBSEQUENT STAGES OF ITS TREATMENT,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
H. Sztrantowicz, and M. Kaniewska-Prus.
Polskie Archiwum Hydrobiologii, Vol. 32, No. 1, p 71-95, 1985. 13 Fig, 34 Ref.

Descriptors: *Vistula River, *Warsaw, *Poland, *Invertebrates, *Bioindicators, Paramecium, Daphnia, Crustaceans, Water pollution, Indicators, Water quality, Water treatment.

Based on previously published data on physical and chemical properties of Vistula River water treated for municipal use in the city of Warsaw the processes of mortality, adaptation and reproduction were traced in Paramecium aurelia, P. caudatum and Daphnia magna. In the case of Protozoa, growth parameters of the population were examined (growth rate, generation time) under effect of changes in water chemical properties. It was shown that there is a dependence between water quality as calculated by the method of averaged discriminants, and mortality of test animals. Seasonal and annual changes in mortality of Daphnia magna in the water examined were also ascertained. The organisms used for studies are good bioindicators for the aquatic environment with a high degree of chemical pollution. (Author's abstract)
W86-01327

ESTIMATING THE EXTENT OF REDUCTION NEEDED TO STATISTICALLY DEMONSTRATE REDUCED NON-POINT PHOSPHORUS LOADING TO LAKE ERIE,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 5G.
W86-01343

METAL CONCENTRATIONS IN THE GROUND WATER OF THE OUCHITA MOUNTAINS, ARKANSAS, U.S.A.,
Arkansas Univ., Fayetteville. Dept. of Geology.
G. H. Wagner, and K. F. Steele.

Water, Air, and Soil Pollution, Vol. 25, No. 3, p 339-347, July, 1985. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Groundwater, *Metals, *Ouachita Mountains, *Arkansas, Manganese, Drinking water, Water quality, Lead, Iron, Zinc, Cadmium, Copper, Cobalt, Nickel, Mercury, Antimony, Strontium, Barium.

Groundwater in the Ouachita Mountains near deposits of Mn-oxide mineral deposits have anomalously high Mn and Fe concentrations in a significant percentage of cases (Mn-50%, Fe-44%) and background concentrations of Mn and Fe for these groundwaters tend to be greater than for lesser mineralized areas. There is some evidence that the trace metals in these Mn mineral deposits also are reflected in greater groundwater concentrations. Barite and cinnabar mineral deposits are similarly reflected in higher concentrations of Ba and Hg, respectively, not only in the groundwater near these deposits, but also generally in the mineralized districts. The concentrations of Mn and Fe in about 30% of the springs exceeded the EPA drinking water criteria of 50 micro-g/L Mn and 300 micro-g/L Fe. Three springs exceeded the EPA criterion for Pb of 50 micro-g/L, one spring exceeded the 2 micro-g/L Hg criterion and no Ba concentrations exceeded the Ba criterion of 1000 micro-g/L. (Baker-IVI)
W86-01357

DETERMINATION OF ALKYLPHENOLS AND ALKYLPHENOL MONO- AND DIETHOXYLATES IN ENVIRONMENTAL SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. Ahel, and W. Giger.
Analytical Chemistry, Vol. 57, No. 8, p 1577-1583, July, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Alkylphenols, Chromatography, Organic compounds, Wastewater analysis, Water analysis, High-performance liquid chromatography, Mass spectrometry, Gas chromatography.

Rapid, reliable and sensitive methods for the quantitative determination of alkylphenols (AP), 4-alkylphenol mono- (AP1EO) and diethoxylates (AP2EO) in wastewaters, natural waters, and sludges were sought. The necessary prerequisites for successful quantitative determinations of chemicals in environmental research are efficient and preferably selective enrichment, effective separation, and specific and sensitive detection. For routine determinations of large numbers of samples, simplicity and ease of operation as well as short analysis times are desirable. The normal-phase high-performance liquid chromatography (HPLC) method for the quantitative determination of 4-nonylphenol, 4-nonylphenol mono- and diethoxylate described largely fulfills these requirements. High-resolution gas chromatography/mass spectrometry and reversed-phase HPLC may serve as confirmatory techniques to ensure correct identifications. A broad range of aqueous and solid samples from different processes of wastewater and sludge treatment and from various compartments of the environment can be analyzed. The method is particularly suitable for investigations of the occurrence and fate of AP, AP1EO and AP1EO in sewage sludges, treated wastewaters and in the aquatic environment. (Baker-IVI)
W86-01389

MICROBIAL ASSAY FOR DETERMINING THE INFLUENCE OF PHYSICOCHEMICAL ENVIRONMENTAL FACTORS ON THE TOXICITY OF ORGANICS: PHENOL,
New York Univ., NY. Lab. of Microbial Ecology.
For primary bibliographic entry see Field 5C.
W86-01407

IMPACT OF LAND-APPLIED INCINERATOR ASH RESIDUE ON A FRESHWATER WETLAND PLANT COMMUNITY,
Massachusetts Univ., Waltham. Suburban Experiment Station.
For primary bibliographic entry see Field 5C.
W86-01466

GRADIENTS OF PIGMENT CONCENTRATION IN MARINE CONTAMINATED SYSTEMS (GRADIENTES PIGMENTARIOS EN SISTEMAS MARINOS SOMETIDOS A EFLUENTES CONTAMINANTES),
Malaga Univ. (Spain). Dept. de Ecologia.
P. Algarra, and F. X. Niell.
Investigacion Pesquera, Vol. 49, No. 1, p 107-119, 1985. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Chlorophyll a, *Marine environment, Water pollution effects, Probability, Pigments.

The Whitney and Darley's method to estimate chlorophyll a free of degradation products, has been compared with the classical method of Talling and Driver which does not discriminate these interferences. Both methods have been used to estimate gradiental changes in three sytems stressed by a single or a double focus. The amount of impact, as a percent, has been estimated by means of a probabilistic method based on Montecarlo methodology using as variable the values of active chlorophyll a. The general discussion of the data suggest problems of theoretical interest. (Author's abstract)
W86-01495

SIMPLE, COMMUNITY LEVEL, ECOTOXICOLOGICAL TEST SYSTEM USING SAMPLES OF PERIPHYTON,
Goeteborg Univ. (Sweden). Dept. of Botany.
H. Blanck.
Hydrobiologia, Vol. 124, No. 3, p 251-261, May, 1985. 8 Fig, 4 Tab, 59 Ref.

Descriptors: *Periphyton, *Photosynthesis, *Phytotoxicity, Water pollution effects, Algae, Ecotoxicity, Aliphatic amines, Industrial wastewater, Textile industry.

The design and performance of a simple, community level ecotoxicological test system is reported. Samples of periphyton communities, established on artificial substratum in natural streams were used to study effects on photosynthetic activity in short-term experiments. Photosynthesis was measured as light-dependent oxygen evolution or as C-14 labeled CO2-incorporation. The variability in photosynthetic activity between samples collected at the same time, expressed as coefficient of variation, was ca. 20%. The variation in sensitivity of periphyton photosynthesis as dependent on sampling season was less than threefold for the two long-chained aliphatic amines and the textile industry effluent studied. Effects of the amines on periphyton from five different streams were also investigated. The ratio between maximum and minimum values of sensitivity was 5.6. It is concluded that the variation in sensitivity between different periphyton communities is similar to or less than that observed for fresh-water algal species. Some advantages with regard to ecological realism of using periphyton communities as test systems are discussed. (Author's abstract)
W86-01507

QUANTITATIVE CHEMOBEHAVIOR OF FISH: AN IMPROVED METHODOLOGY,
Texas A and M Univ., College Station. Dept. of Veterinary Anatomy.
A. D. Scarfe, C. W. Steel, and G. K. Rieke.
Environmental Biology of Fishes, Vol. 13, No. 3, p 183-194, July, 1985. 7 Fig, 27 Ref.

Descriptors: *Fish behavior, *Monitoring, *Octagonal fluvarium, Behavior, Water pollution, Odor, Chemobehavior, Food habits.

A new behavioral monitoring system, an 'octagonal fluviarium', and associated time-series analytical techniques were developed to quantitatively examine and assess the chemobehavior of fish to waterborne chemicals. Together they aid in the solution of many of the quantitative behavioral and physical problems inherent in earlier experimental approaches. The fluviarium utilizes a quasi-circular channel in which fish are able to move freely through any of eight areas, any of which can receive a predetermined concentration of a chemical stimulus. Movements and preferential stays of animals monitored with a video system are analyzed to determine spatial and temporal preference in their distributions within the system in response to introduced chemicals. The advantages of these designs include precise control of the water flow dynamics affecting the odor plume, virtual elimination of the 'wall-hugging' tendency of animals due to the quasi-circular construction of the octagonal trough, and the assessment of temporal changes in the behavioral responses of the animals which can be correlated with the presence of odoriferous cues. The efficacy of the fluviarium and statistical analysis is illustrated with data on the chemoresponse of zebrafish, Brachydanio rerio, to 0.001 M L-alanine. This system should have extensive application in investing the chemoresponses of aquatic organisms to waterborne chemicals (presented singularly and in combinations) such as food substances, pheromones or pollutants. (Author's abstract)
W86-01509

MONITORING AND EVALUATION OF WATER POLLUTION IN TUMEN RIVER BY MEANS OF ALGAE (IN CHINESE),
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W86-01512

ORGANOCHLORINES AND TRACE METALS IN GREEN-LIPPED MUSSELS PERNA VIRIDIS FROM HONG KONG WATERS: A TEST OF INDICATOR ABILITY,
Environmental Protection Agency, Kowloon (Hong Kong).
D. J. H. Phillips.
Marine Ecology - Progress Series, Vol. 21, No. 3, p 251-258, February, 1985. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Bioindicators, *Chlorinated hydrocarbons, *Trace metals, *Mussels, *Hong Kong, Copper, Lead, Cadmium, Mercury, Zinc, DDT, Polychlorinated biphenyls, Pesticides, Coastal waters.

While the use of biological indicators to quantify aquatic pollution by trace elements and organochlorines is well-established in temperate waters, this technique has been relatively little used in tropical areas. This is partly because a suitable species has yet to be identified. In South-East Asia, the green-lipped mussel Perna viridis (Linnaeus) has been proposed as a candidate for regional bioindicator studies. The capacity of P. viridis to act as an efficient and accurate bio-indicator for trace metals and organochlorines has been tested in Hong Kong coastal water, using samples from 15 locations. It is concluded that P. viridis is an excellent bio-indicator species for studies of copper and lead. Its use to monitor cadmium, mercury and zinc requires further study, however; in particular, the mussel may partially metabolically regulate zinc concentrations in its tissues. P. viridis appears to be a capable indicator species for organochlorines; the data reported here reveal a generalized contamination of Victoria Harbor by DDT and its metabolites, and localized pollution by PCBs. (Author's abstract)
W86-01514

POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER: THE VALUE OF INDIVIDUAL PACKED-COLUMN PEAK ANALYSIS,
Lamont-Doherty Geological Observatory, Palisades, NY.
H. J. Simpson, R. F. Bopp, B. L. Deck, S. Warren, and N. Kostyk.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 159-165. 10 Fig, 6 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Packed-column peak analysis,

*Chemical analysis, *Fate of pollutants, Chlorinated hydrocarbons, Sediments, Chemical composition.

As the result of discharges of approximately 500 tons of PCBs since the 1940's, the sediments, water and biota of the Hudson River (New York) over a 300 km reach are contaminated to a level up to several orders of magnitude greater than other large urban river-estuaries in North America. Although the original contamination probably consisted predominantly of unmodified commercial PCB mixtures, especially Aroclor 1242 which was released about 80 km upstream of tidal waters, the cumulative effect of physical and biological processes, including sorption and desorption to and from suspended particles and sediments plus gas exchange between the water and atmosphere, has been to accomplish major changes in PCB component composition in sediments along the axis of the tidal Hudson. Much of the scientific value of environmental PCB measurements in the Hudson is lost by reporting of data as total PCB concentrations, rather than in terms of a number of distinct components. Ideally, each of the more than 100 individual PCB congeners that can be analyzed in environmental samples by capillary column chromatography should be separately reported, but in practice a significant advance would be accomplished by expressing data in terms of mass of PCB represented by individual peaks resolved by packed-column chromatography (each peak includes several distinct compounds with very similar physiochemical properties). Less informative, but never the less of considerable value, is the practice of reporting data in terms of one or more commercial Aroclor mixtures, especially if the method of standardization is carefully documented (i.e. which chromatogram peaks are actually used for both the standard and sample). Comparison of PCB compositions based on individual packed-column peak analysis in depth segments of a sediment core from near the upstream end of the tidal Hudson demonstrates that even relatively subtle changes in PCB source composition (conversion from Aroclor 1242 to Aroclor 1016), such as occurred at the upstream G. E. facilities in 1971-1972, can be clearly observed in the sediments many 10's of km downstream of the release points, providing a useful stratigraphic marker. In contrast to such subtle changes in PCB source composition to the tidal fresh-water Hudson, major differences are observed in sediment PCB composition near New York City. In an area such as Jamaica Bay, which is largely isolated from the influence of downstream transport of PCBs from the capacitor plant releases, sediment PCBs contain much greater proportions of higher chlorinated biphenyls (penta-octachlorobiphenyls) than the main stem of the Hudson, probably due to the impact of domestic sewage discharges. Such large difference in composition provide the single most useful set of information for characterizing sources and transport properties of this family ot toxic contaminants in the Hudson. (Author's abstract)
W86-01556

IDENTIFYING POLLUTION RELATED CHANGES IN CHIRONOMID COMMUNITIES AS A FUNCTION OF TAXONOMIC RANK,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-01583

DISCRIMINATION OF THE STOCK OF FISH (EELS, ANGUILLA ROSTRATA) BASED ON THE PRESENCE OF THE SYNTHETIC CHEMICAL MIREX (DISCRIMINATION D'UN STOCK DE POISSON, L'ANGUILLE (ANGUILLA ROSTRATA), BASEE SUR LA PRESENCE D'UN PRODUIT CHIMIQUE DE SYNTHESE, LE MIREX),
Department of Fisheries and Oceans, Quebec. Fisheries Research Branch.
For primary bibliographic entry see Field 5C.
W86-01584

BENTHIC ORGANISMS AS INDICATORS OF WATER QUALITY IN LAKE PATZCUARO, MEXICO,
Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
I. Rosas, M. Mazari, J. Saavedra, and A. P. Baez.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 401-414, August, 1985. 8 Fig, 3 Tab, 34 Ref.

Descriptors: *Lake Patzcuaro, *Mexico, *Benthos, *Water quality, *Bioindicators, Water pollution effects, Bacterial analysis, Animal wastes, Invertebrates, Aquatic plants, Wastewater pollution.

The water quality was evaluated in Lake Patzcuaro by biological methods using bacteria and macroinvertebrates as indicators, as well as physicochemical parameters. The bacteriological determinations showed critical areas near the two main villages, Patzcuaro and Janitzio. The bacterial ratio FC/FS indicated significant amounts of animal excreta throughout the lake. In areas with less urban influence where there was an abundance of immersed vegetation, the benthic macroinvertebrate community presented high Bioic, Diversity, and Equitability indices, which were > 2, > 2, and > 0.6, respectively. At the most polluted station (station 8), oligochaetes, which are tolerant to organic matter, comprised 94% of the organisms. Physicochemical characteristics are similar in the lake, except at station 8 where the lowest dissolved oxygen levels, highest ammonia and phosphorus concentrations were registered. This area, adjacent to a fish processing plant, is affected by domestic and industrial wastewater discharges. The results show that up to the present the lake has been moderately polluted, but critical zones exist that restrict the use of the lake for water supply and recreational purposes. (Author's abstract)
W86-01608

STRIPPING ANALYSIS AND CHROMATOGRAPHIC SNIFFING FOR THE SOURCE IDENTIFICATION OF ODOROUS COMPOUNDS IN DRINKING WATER,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 7B.
W86-01696

ANALYSIS OF VARIANCES AS DETERMINED FROM REPLICATES VS. SUCCESSIVE SAMPLING,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-01698

USE OF IONIC MIXING CURVES IN DIFFERENTIATING OIL FIELD BRINE FROM NATURAL BRINE IN A FRESH WATER AQUIFER,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
V. A. Mast.
Ground Water Monitoring Review, Vol. 5, No. 3, p 65-69, Summer, 1985. 5 Fig, 2 Tab, 4 Ref.

Descriptors: *Pollutant identification, *Brines, *Saline water intrusion, Dissolved solids, Chlorides, Statistical studies, Model studies, Water pollution sources.

The study and analytical technique used to determine the relative contribution of various pollution sources to the increased salinity of the fresh water aquifer in the south Wichita, Kansas area were investigated. A statistical model is presented which has proven to be a valuable tool in determining the percentage contribution of pollution from the various sources of contaminants. For the most reliable factors, chloride and total dissolved solids, the volumetric percentage contribution of oil field brine and Wellington Formation natural brine at the bottom of the aquifer ranged from 6.5% to 8.5% and 6.8% to 7.1%, respectively. For the analytical model itself, two drawbacks are pointed out. First, the water system in the model is highly simplified. For a system with more than two potential pollutant sources, this analysis will not serve a proper function. Second, the choice of factor pairs is site dependent. With different geological environments, as well as different pollutant types, the factor pairs used must be chosen accordingly. Three suggestions are made for future analysis in multisource pollution systems: for the unsteady-state system, a time factor should be included in the analysis; for a system of N number of pollutant sources, factor group of N items should be used for analysis; and every item in the factor group selected should represent the characteristics of the respective pollutant sources. (Baker-IVI)
W86-01699

GROUND WATER QUALITY ANOMALIES ENCOUNTERED DURING WELL CONSTRUCTION, SAMPLING AND ANALYSIS IN THE ENVIRONS OF A HAZARDOUS WASTE MANAGEMENT FACILITY,
Woodward-Clyde Consultants, Walnut Creek, CA. Environmental and Engineering Services.
D. Dunbar, H. Tuchfeld, R. Siegel, and R. Sterbentz.
Ground Water Monitoring Review, Vol. 5, No. 3, p 70-74, Summer, 1985. 1 Fig, 3 Tab, 1 Ref.

Descriptors: *Water quality, *Monitoring, *Well construction, Construction, Wells, Hazardous waste, Hydrogeology, Waste disposal, Aquifer characteristics, Potentiometry, Tetrahydrofuran, Trihalomethanes, Organic compounds, Water pollution sources.

The occurrence of a number of ground water quality anomalies during field investigations demonstrates the need for careful attention to specialized well construction, sampling and analytical procedures. The specific anomalies and their corresponding causes include elevated pH values due to poor well construction procedures; the presence of tetrahydrofuran, caused by the use of glue at casing joints; the temporary occurrence of trihalomethanes produced during the breakdown of synthetic drilling fluid; and cross contamination of groundwater samples due to incomplete equipment decontamination procedures. (Baker-IVI)
W86-01700

REDUCTION OF HEXAVALENT CHROMIUM IN WATER SAMPLES ACIDIFIED FOR PRESERVATION,
Geological Survey, Denver, CO.
K. G. Stollenwerk, and D. B. Grove.
Journal of Environmental Quality, Vol. 14, No. 3, p 396-399, 1985. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Chromium, *Sample preservation, *Hexavalent chromium, Water chemistry, Preservation, Chemical reactions, Hydrogen ion concentration, Nitrates, Organic carbon, Water temperature.

Reduction of hexavalent chromium, Cr(VI), in water samples, preserved by standard techniques, was investigated. The standard preservation technique for water samples that are to be analyzed for Cr(VI) consists of filtration through a 0.45-micro-m membrane, acidification to a pH < 2, and storage in plastic bottles. Batch experiments were conducted to evaluate the effect of H(+) concentration, NO2, temperature, and dissolved organic carbon (DOC) on the reduction of Cr(VI) to CR(III). The rate of reduction of Cr(VI) to Cr(III) increased with increasing NO2, DOC, H(+), and temperature. Reduction of Cr(VI) by organic matter occurred in some samples even though the samples were unacidified. Reduction of Cr(VI) is inhibited to an extent by storing the sample at 4 C. Stability of Cr(VI) in water is variable and depends on the other constituents present in the sample. Water samples collected for the determination of Cr(VI) should be filtered (0.45-micro-m membrane), refrigerated, and analyzed as quickly as possible. Water samples should not be acidified. Measurement of total Cr in addition to Cr(VI) can serve as a check for Cr(VI) reduction. If total Cr is greater than Cr(VI), the possibility that Cr(VI) reduction has occurred needs to be considered. (Author's abstract)
W86-01713

ESTIMATING ALGAL AVAILABLE PHOSPHORUS IN SUSPENDED SEDIMENTS BY CHEMICAL EXTRACTION,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. A. Dorich, D. W. Nelson, and L. E. Sommers.
Journal of Environmental Quality, Vol. 14, No. 3, p 400-405, 1985. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Phosphorus, *Algae, *Suspended sediments, *Chemical analysis, *Extraction, Sediments, Bioavailability, Nutrients, Cycling nutrients.

The availability of sediment inorganic phosphorus (P sub i) to algae was determined in 28 suspended stream sediments collected from an agricultural watershed in northeastern Indiana by short (2-d) and longer-term (14-d) incubations. Unincubated sediment was also analyzed for dissolved molybdate reactive P sub i (DMRP) and P sub i extracted by: (i) sequential NaOH and HCl, (ii) sequential NH4F, NaOH, and HCl, (iii) nitrilotriacetic acid (NTA), (iv) hydroxy-Al resin, and (v) total P. Available P (P sub aa) measured in sediments by 2-d and 14-d incubations with algae averaged 21 and 25% of total sediment P, respectively. Extraction of sediments with 0.1 M NaOH, 0.5 M NH4F, sequential 0.5 M NH4F + 0.1 M NaOH, NTA, and hydroxy-Al resin removed an average of 36, 22, 31, 45, and 17% of the total P, respectively. Of the extractants tested, NaHO-extractable P sub i was significantly correlated with 2-d and 14-d P sub aa ($r = 0.89^{***}$ and 0.95^{***}, respectively) but NaOH extraction removed amounts of P sub i that exceeded sediment P sub aa by a relatively constant amount. The results suggest that a single extraction with 0.1 M NaOH can be used to estimate both short- and longer-term P sub aa in suspended stream sediments derived from noncalcareous soils in the Northcentral USA. (Author's abstract)
W86-01714

DETERMINATION OF POTASSIUM, SODIUM, CALCIUM, AND MAGNESIUM IN NATURAL WATERS BY ION CHROMATOGRAPHY,
Iowa State Univ., Ames. Dept. of Agronomy.
N. T. Basta, and M. A. Tabatabai.
Journal of Environmental Quality, Vol. 14, No. 3, p 450-455, 1985. 4 Fig, 5 Tab, 20 Ref.

Descriptors: *Potassium, *Sodium, *Calcium, *Magnesium, *Chemical analysis, *Ion chromatography, Chromatography, Conductimetric detection, Metals, Iron.

Simultaneous determination of alkali and alkaline earth metals in water samples is needed. Studies to evaluate the Dionex Model 10 Ion Chromatograph (IC) for simultaneous determination of K and Na or Ca and Mg in diverse types of natural waters, including soil extracts, showed that the results by the IC method closely agreed with those obtained by flame photometry for K and Na and by atomic absorption spectrophotometry of K, Na, Ca, and Mg. The IC method is based on separation of the monovalent and divalent cations by a separator column containing a low-capacity sulfonated divinylbenzene polystyrene copolymer, cation-exchange resin in the H(+) form and on converting the various metal ions to their corresponding hydroxides by a suppressor column containing a high-capacity, anion-exchanged resin in the OH(-) form. The eluent used for determination of alkali metals was 5 mM HCl, and a solution containing 2.5 mM HCl + 2.5 mM m-phenylenediamine dihydrochloride was used for determination of alkaline earth metals. Electrical conductivity is used as the mode of detection. The method is precise, accurate, and can detect as little as 0.1 mg/L of K, Na, Ca, or Mg in water samples. The coefficient of variation values ranged from 1.3 to 5.0% for K, from 0.63 to 9.1% for Na, from 1.9 to 3.5% for Ca, and from 0 to 24% for Mg. With the IC method, K and Na or Ca and Mg can be determined simultaneously in 2 mL of water in approximately 7 min. A single operator can perform about 40 analyses of alkali or alkaline earth metals in a normal working day. Successive analyses of waters containing high concentrations of metals (e.g., Fe) may lead to loss of resolution of alkali metals, but this can be restored by washing the separator column with 3 M HCl saturated with EDTA. (Author's abstract)
W86-01717

PRECONCENTRATION AND X-RAY SPECTROMETRIC DETERMINATION OF ARSENIC(III/V) AND CHROMIUM(III/VI) IN WATER,
Link Systems Ltd., High Wycombe (England).
D. E. Leyden, K. Goldbach, and A. T. Ellis.
Analytica Chimica Acta, Vol. 171, p 369-374, 1985. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Spectrometry, *Arsenic, *Chromium, Water analysis, Chemical analysis, Speciation.

Two precipitation methods have been used successfully to determine chromium and arsenic in their respective oxidation states in water samples. The DBDTC (dibenzyldithiocarbamate) precipitation method recovers Cr(VI) and As(III) selectively over Cr(III) and As(V) as a first precipitation step. The remaining Cr(III) and As(V) are quantified in a second step by coprecipitation with hydrated iron(III) oxide. Sensitivity is higher for chromium and arsenic by the DBDTC method because of increased matrix absorption for iron(III) in the coprecipitated samples. The method will likely not supplant atomic absorption or inductively coupled plasma emission spectrometry for accuracy and precision, but it does provide speciation information and a fast economical method. Standards can be stored indefinitely. (Baker-IV)
W86-01719

ZIRCONIUM COPRECIPITATION FOR SIMULTANEOUS MULTIELEMENT DETERMINATION OF TRACE METALS IN SEAWATER BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY,
Tokyo Univ. (Japan). Dept. of Chemistry.
T. Akagi, Y. Nojiri, M. Matsui, and H. Haraguchi.
Applied Spectroscopy, Vol. 39, No. 4, p 662-667, 1985. 3 Fig, 5 Tab, 38 Ref.

Descriptors: *Zirconium, *Coprecipitation, *Precipitation, *Chemical analysis, *Seawater, *Inductively Coupled Plasma Atomic Emission Spectrometry, *Trace metals, Metals, Preconcentration, Spectroscopy, Atomic emission spectrometry, Inductively coupled plasma.

Zirconium coprecipitation for simultaneous multielement determination of trace metals in seawater has been examined by inductively coupled plasma atomic emission spectrometry. Optimum pH conditions and other experimental procedures for coprecipitation were investigated in order that the method for multielement preconcentration could be evaluated. The concentration factor of 20 times the original concentration was obtained, although it was limited by spectral interference with zirconium. The present coprecipitation method improved the detection limits and other analytical figures of merit for 17 trace metals (Al, As, Cd, Co, Cr, Cu, Fe, La, Mn, Mo, Ni, Pb, Sb, Ti, V, Y, and Zn), which were estimated by the use of artificial seawater samples, and it was applied to natural seawater analysis. (Author's abstract)
W86-01720

ATTENUATION VERSUS TRANSPARENCY,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler.
Journal of Environmental Engineering, Vol. 111, No. 4, p 448-459, August, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Light attenuation, *Transparency, *Secchi disks, Downwelling irradiance, Absorption, Scattering, Solar radiation, Physical properties, Physicochemical characteristics.

The differential response of the two commonly used measures of light penetration in water, Secchi disc transparency (SD, m) and the attenuation coefficient for downwelling irradiance (Kd, per m), to the light attenuating processes of absorption and scattering is described. The commonly invoked constancy in the product Kd x SD should only be expected when the relative contributions of scattering and absorption of Kd remains uniform. A number of scenarios and documented phenomena are presented for which preferential effects on scattering or absorption, and therefore variable values of Kd x SD, are expected. Measurement errors also contribute to variability in Kd x SD, particularly at low (< 1.5 m) SD values. Paired observations of Kd and SD presented from four different systems, representing a wide range of Kd and SD values, demonstrate the variability of the magnitude of Kd x SD within individual systems. Secchi disc transparency is probably not a reliable indicator of Kd in many systems. The uncertainty associated with invoking the constancy of Kd x SD in various ecological modeling efforts, in which Kd measurements are missing or are temporally limited, should be accommodated. (Author's abstract)
W86-01725

DETERMINATION OF METHYLMERCURY BY PHASE-SENSITIVE A.C. POLAROGRAPHY,
Institutul Politehnic din Bucuresti (Romania). Dept. of Analytical Chemistry.
I. Ioneci, I. Tanase, and C. Luca.
Analytical Letters, Vol. 18(A8), p 929-945, May, 1985. 6 Fig, 64 Ref.

Descriptors: *Methylmercury, *Polarography, Pollutant identification, Mercury compounds, Organic compounds, Water analysis.

Direct determination of organically-bound mercury in water is very difficult because of the high volatility of the organomercury compounds. A method is described for the determination of methylmercury in water using polarography. The polarographic reduction of methylmercury in aqueous medium takes place in two steps, each of which involves the transfer of a single electron. The first reduction step proceeds reversibly both in direct current and in sinusoidal alternating current (a.c.). Since the polarograms corresponding to this step are well defined, they can be successfully used to determine methylmercuric compounds by phase-sensitive sinusoidal a.c. polarography, in the concentration range 1 x 10 to the minus 7th power to 1 x 10 to the minus 4th power mole/cu dm. Phase-sensitive sinusoidal a.c. polarography offers an advantageous way of determining methylmercury in the presence of inorganic mercury and also in the presence of other forms of organically-bonded mercury, especially of phenylmercury, an advantage not offered by any other known analytical technique. (Moore-IVI)
W86-01755

COPPER AND SILVER ACCUMULATION IN TRANSPLANTED AND RESIDENT CLAMS (MACOMA BALTHICA) IN SOUTH SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA.
D. J. Cain, and S. N. Luoma.
Marine Environmental Research, Vol. 15, p 115-135, 1985. 7 Fig, 1 Tab, 45 Ref.

Descriptors: *Copper, *Silver, *Clams, *Bioaccumulation, Bioindicators, Heavy metals, Water pollution effects, San Francisco Bay, California.

Accumulation of Cu and Ag by soft tissues of the deposit-feeding clam Macoma balthica was less than half in clams transplanted to a contaminated area than in clams native to that area. During a period of tissue growth, the transplants retained 50% and 90%, respectively, of the net Cu and Ag accumulated, but loss of metals from soft tissue by the resident population equalled net accumulation. Copper accumulation in the transplants did not occur during some periods when increases in the metal body burden of the resident population indicated that environmental exposures were high. The difference in metal accumulation of the two groups of clams may be the result of past environmental exposures. The results illustrate some limitations of using transplant as indicators of pollution events or

of pollutant impact upon resident populations. (Author's abstract)
W86-01793

EFFECT OF SEAWATER MAGNESIUM ON NATURAL FLUORESCENCE DURING ESTUARINE MIXING, AND IMPLICATIONS FOR TRACER APPLICATIONS,
North Carolina Univ. at Wilmington. Div. of Chemistry.
For primary bibliographic entry see Field 2L.
W86-01801

DETERMINATION OF ZINC, CADMIUM, LEAD AND COPPER IN PRECIPITATION BY COMPUTERIZED DIFFERENTIAL PULSE VOLTAMMETRY,
Netherlands Energy Research Foundation ECN, Petten.
W. A. Lingerak, A. M. v. Wensveen-Louter, and J. Slanina.
International Journal of Environmental Analytical Chemistry, Vol. 19, p 85-98, 1985. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Chemistry of precipitation, *Zinc, *Cadmium, *Lead, *Copper, *Differential pulse voltammetry, Voltammetry, Heavy metals, Chemical composition, Computers.

A method is described for the determination of metals in rainwater by means of differential pulse anodic stripping voltammetry. Organic interferants are removed by passing the sample over active carbon at pH < or = 1. A symmetrical, mercury-drop electrode flow through cell is mounted on a PAR 303 electrode stand. The polarography and the flow injection sample handling system are computer controlled. Results are obtained by means of a calibration graph, standard additions are not necessary. Results for Zn, Cd, Pb and Cu in rainwater are in agreement with results obtained by AAS. (Author's abstract)
W86-01846

DETERMINATION OF COMMON ANION CONCENTRATIONS IN SURFACE AND GROUNDWATER SAMPLES BY ELUENT-SUPPRESSED ION CHROMATOGRAPHY,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
P. C. Jay, and J. M. Judd.
International Journal of Environmental Analytical Chemistry, Vol. 19, p 99-109, 1985. 3 Fig, 7 Tab, 13 Ref.

Descriptors: *Ion chromatography, *Eluent suppression, *Anions, *Chemical composition, Fluoride, Chloride, Phosphates, Nitrates, Sulfates, Natural waters, Surface waters, Groundwater.

The use of ion chromatography with eluent suppression is particularly suited to determine concentrations of F(-), Cl(-), PO4(-3), NO3(-) and SO4(-2) in natural surface and ground water samples. An automated system using hollow-fiber suppressors was developed. All anions yield linear responses up to the highest concentrations and the relative standard deviation is <3% in all determinations except the lowest F(-) and Cl(-) concentrations. Analytical precision for both standard anion solutions and samples is similar. Peak height and peak area quantification are compared and the effects of high Cl(-) content, pH, storage and filtration on sample analysis are determined. Recalibraton, using a standard anion solution inserted at every fifth position on the auto sampler holding tray, improves and maintains analytical precision. Recalibration is essential if high precision is sought in analysis by ion chromatography with eluent suppression. (Moore-IVI)
W86-01847

DETERMINATION OF NONIONIC SURFACTANTS IN WATER BY ATOMIC ABSORPTION SPECTROMETRY,
Antwerpse Waterwerken (Belgium).
F. M. Van Hoof, W. J. Van Craenenbroeck, and J. K. Dewaele.
International Journal of Environmental Analytical Chemistry, Vol. 19, p 155-164, 1985. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Surfactants, *Atomic absorption spectrometry, Sublation, Ion exchange, Pollutant identification, River Meuse, France, Belgium, Netherlands.

An analytical method for nonionic surfactants has been developed using sublation and ion-exchange for isolation of the surfactants and complex formation with potassium zinc tetrathiocyanate followed by atomic absorption spectrophotometric assay of zinc released from the complex through acid extraction. The detection limit for this method is 0.01 mg/l Triton X-100. Recoveries higher than 90% were obtained starting from samples spiked with 0.1 mg/l Triton X-100. The method has been applied to 70 surface water samples coming from a quality survey of the River Meuse in France, Belgium and The Netherlands organized by the RIWA-Cooperating Rhine and Meuse Water Supply Companies. The highest level (0.50 mg/l) was found below the outfall of a surfactant-producing firm. Downstream these discharge levels decreased rapidly. (Author's abstract)
W86-01848

VARIABILITY OF ALUMINUM CONCENTRATIONS IN ORGANS AND WHOLE BODIES OF SMALLMOUTH BASS (MICROPTERUS DOLOMIEUI),
Columbia National Fisheries Research Lab., MO.
W. G. Brumbaugh, and D. A. Kane.
Environmental Science and Technology, Vol. 19, No. 9, p 828-831, 1985. 6 Tab, 20 Ref.

Descriptors: *Aluminum, *Bass, Metals, Pollutant identification, *Fish, Atomic absorption spectrophotometry, Gills, Water pollution effects, Animal tissues.

Variability of aluminum concentrations in smallmouth bass (Micropterus dolomieui) was evaluated by analysis with graphite furnace atomic absorption spectrophotometry. Fish analyzed as whole bodies were compared to fish which had selected organs analyzed individually and separately from the carcass. Gastrointestinal tract contents contained highly variable amounts of aluminum and caused bias and increased variability when included in whole-body samples. Since aluminum concentrations in tissues of stomach and intestine were similar to those in the whole body (less gastrointestinal tract contents), the entire gastrointestinal tract and contents could be removed to reduce bias and variability without measurably altering the 'true' whole-body aluminum concentrations. Of the organs analyzed, gill filaments had the highest and most variable aluminum concentrations and may have contributed to within-fish whole-body variability because of incomplete homogenization. (Author's abstract)
W86-01872

BIOCONCENTRATION FACTORS OF SOME HALOGENATED ORGANICS FOR RAINBOW TROUT: LIMITATIONS IN THEIR USE FOR PREDICTION OF ENVIRONMENTAL RESIDUES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5C.
W86-01874

FRESHWATER AQUATIC MACROPHYTES AS HEAVY METAL MONITORS - THE OTTAWA RIVER EXPERIENCE,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
D. C. Mortimer.
Environmental Monitoring and Assessment, Vol. 5, No. 3, p 311-323, September, 1985. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Macrophytes, *Heavy metals, Monitoring, Seasonal variation, Plant growth, Lead, Mercury, Nickel, Copper, Aquatic plants, Ottawa River.

The ability of freshwater aquatic vascular plants to accumulate heavy metals was examined in some detail during a five year study. Differences in uptake rate were found to depend on the species of plant, the seasonal growth rate changes and the metal ion being absorbed. Lead and mercury were concentrated to a greater extent than the lighter nickel and copper. Laboratory experiments were designed to establish uptake rate constants which were used to calculate water concentrations of mercury from the analyses of plant samples from the river. 'Background' levels of mercury in aquatic plants of 35-50 ng/L dry weight corresponded to a water concentration near 15 ng/L of total mercury of which 25-30% was methyl-mercury. Higher concentrations of mercury in the plants indicated a proportional increase in the mercury level in the water. (Author's abstract)
W86-01887

AVOIDANCE TEST OF A FISH, MEDAKA (ORYZIAS LATIPES), TO AQUATIC CONTAMINANTS, WITH SPECIAL REFERENCE TO MONOCHLORAMINE,
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
H. Hidaka, and R. Tatsukawa.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 565-571, September, 1985. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Fish behavior, *Monochloramine, *Avoidance, Medaka, Bioindicators, Toxicity, Chlorine, Surfactants, Residual chlorine, Chloramines, Water pollution effects.

The avoidance behavior of fish is a sensitive indicator for aquatic contaminants such as surfactants, pesticides, and residual chlorine. A monochloramine avoidance test was carried out using medaka (Oryzias latipes) in a small modular chamber system with a symmetrical parallel-flow. In the apparatus, the diluted toxicant solution and the control water run parallel with a distinct boundary at the center of the chamber. The significant avoidance concentration (P = 0.05) was 5.7 micro-g/L as combined residual chlorine, which is the lowest residual chlorine avoidance concentration reported in the literature. The avoidance curves for monochloramine exhibited a pattern similar to those for anionic surfactants. As the avoidance behavior of fish is a sensitive indicator, this avoidance test may be used as one of the standard methods for ecotoxicological studies. (Moore-IVI)
W86-01888

COLORIMETRIC DETERMINATION OF PROPOXUR RESIDUES IN VEGETABLES AND WATER,
Central Food Technological Research Inst., Mysore (India). Analytical Quality Control Lab.
K. M. Appaiah, M. A. Sreenivasa, and O. P. Kapur.
Bulletin of Environmental Contamination and Toxicology, Vol. 296-300, September, 1985. 2 Tab, 17 Ref.

Descriptors: *Propoxur, *Insecticides, *Colorimetry, India, Pollutant identification, Water analysis, Pesticide residues.

Propoxur is a non-systemic insecticide used on a large scale in India on field crops. Although gas and liquid chromatographic methods are ideal for detecting and quantifying propoxur residues their use is often limited by availability and cost of equipment. The advantages of the colorimetric method proposed are that it does not require elaborate clean-up technique, gives high recovery, produces a stable color and is as sensitive as the method which uses 4,4-diaminodiphenyl sulfone as the chromogenic reagent. The phenol obtained after alkaline hydrolysis of propoxur is treated with concentrated nitric and sulfuric acids to get nitrosophenol which is in the presence of excess of alcoholic ammonium hydroxide rearranges to form a highly colored quinoid salt. The color is stable for weeks. To check the adequacy of the method, water and vegetable samples were fortified with known amounts of propoxur and analyzed. Recov-

eries ranged from 95.1 to 98.0% for water samples, and 93.5 to 97.8% for vegetable samples. (Baker-IVI)
W86-01895

DAPHNIA MAGNA AS AN INDICATOR OF THE ACUTE TOXICITY OF WASTE WATERS,
National Board of Waters, Helsinki (Finland). Water Research Inst.
E. Nikunen, and V. Miettinen.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 368-374, September, 1985. 1 Tab, 21 Ref.

Descriptors: *Daphnia, *Toxicity, *Wastewater disposal, *Water pollution effects, *Bioindicators, Indicators, Zooplankton, Pulp wastes, Pulp and paper industry, Industrial wastewater.

The proposed Finnish standard for both chemical and wastewater testing is described and results obtained with different industrial wastewaters using the test method are presented. The wastewater samples taken for the experiments were mainly chosen by the local water authorities. The majority of the tested effluents were taken form the pulp and paper industry, which is the most important polluter of the Finnish waters. The tests conducted on Daphnia magna indicated that the proposed Finnish standard is a fairly rapid and easy method for measuring the acute lethal toxicity of waste water samples. Pulp and paper mills had clearly the biggest toxicity emission rates of the samples investigated. Just one other plant, producing viscose fibers, had a TER (toxicity emission rate) value which was in the same order of magnitude as the median values of wastewaters released from different pulp producing plants. (Baker-IVI)
W86-01905

MONITORING OF POLYCHLORINATED BIPHENYLS (PCBS) AND HEXCHLOROCYCLOHEXANES (HCH) IN FRESHWATER USING THE AQUATIC MOSS CINCLIDOTUS DANUBICUS,
Metz Univ. (France). Lab. d'Ecologie.
C. Mouvet, M. Galoux, and A. Bernes.
Science of the Total Environment, Vol. 44, p 253-267, 1985. 2 Fig, 6 Tab, 64 Ref.

Descriptors: *Monitoring, *Polychlorinated biphenyls, *Hexachlorocyclohexanes, *Mosses, *Bioindicators, Indicators, Organic compounds, Water pollution effects, Fate of pollutants, Pesticides.

The use of aquatic bryophytes for the monitoring of polychlorinated biphenyls (PCBs) and chlorinated pesticides alpha-, beta-, and gamma-HCH in freshwaters was investigated. Concentrations of alpha- and beta-HCH in Cinclidotus danubicus from the Saone (France) were below the detection limit. The contamination of the mosses by gamma-HCH did not vary much along the course of the river even though the site farthest downstream appeared less contaminated than the three other sites located in more agricultural areas. Polychlorinated biphenyls were detected at the four sites studied with no significant variation along the course of the river. Concentations of alpha-, beta- and gamma-HCH in water samples from Les Mees, 4 km downstream from a discharge site indicate the extreme contamination of the Durance. Polychlorinated biphenyl concentrations were below the detection limit. A progressive increase in the contaminant concentrations in C. danubicus transplanted to the polluted stretch of the river was observed. Polychlorinated biphenyls were detected in all moss samples with slight variations between sites and no significant change as a function of time. (Baker-IVI)
W86-01916

5B. Sources Of Pollution

INDICATORY ROLE OF SOME INVERTEBRATES FOR QUALITY OF WATER IN THE VISTULA RIVER AND IN SUBSEQUENT STAGES OF ITS TREATMENT,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 5A.
W86-01327

OCCURRENCE AND TRANSPORT OF ORGANIC MACROCONTAMINANTS IN THE DULUTH-SUPERIOR HARBOR,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. A. Bahnick, and T. P. Markee.
Journal of Great Lakes Research, Vol. 11, No. 2, p 143-155, 1985. 2 Fig, 7 Tab, 29 Ref. Dept. of Commerce grant NA 800AA-D-00086.

Descriptors: *Fate of pollutants, *Duluth-Superior Harbor, *Great Lakes, *Organic compounds, Pollutant transport, Lake sediments, Suspended sediments, Polychlorinated biphenyls, Aromatic hydrocarbons, Pentachlorophenol.

The Duluth-Superior harbor is a major Great Lakes port serving about 10,000 commercial and recreational vessels annually. The nature and magnitude of certain organic microcontaminants associated with harbor sediments and suspended particulate matter subject to transport to Lake Superior were investigated. The microcontaminants included polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAH), and pentachlorophenol (PCP). The results of initial screening of particulate samples obtained from Duluth harbor in 1980 identified about 200 compounds in four extract fractions. The compound types consisted mainly of hydrocarbons, organic acids, esters, and alcohols. In addition some amines, ketones, aldehydes and phenols were detected. These compounds appear to be primarily plant decomposition products. GC/MS analysis in 1982 suggests the presence of a very large number of compounds, particularly in sediment sample extracts. Most appear to be naturally occurring organics. Some PAH compounds were also identified. Dichlorobenzene was the only halogenated compound identified from this data. In 1983, particulates were sampled in yet another site. Five PAH compounds were identified by retention times. PCP was detected in sediments and particulates collected from sites 1 and 2 in Duluth Harbor in 1982. Particulate samples contained higher concentrations of PCBs than did sediments. This may be due to a larger surface area and a higher organic content. Considering the concentration of PCBs in water and particulates in conjunction with average suspended solids levels, it was calculated that 91% of the PCBs were dissolved in water and 19% associated with suspended particles. Suspended solid transport of PCBs and PAH to Lake Superior is less than 0.01% of airborne transport. (Baker-IVI)
W86-01346

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN SEDENTARY FISH FROM LAKE HURON AND LAKE SUPERIOR TRIBUTARIES AND EMBAYMENTS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Jaffe, E. A. Stemmler, B. D. Eitzer, and R. A. Hites.
Journal of Great Lakes Research, Vol. 11, No. 2, p 156-162, 1985. 1 Fig, 2 Tab, 26 Ref. EPA grant R005737-01.

Descriptors: *Organic compounds, *Halogenated hydrocarbons, *Fish, *Water pollution sources, Lake Huron, Lake Superior, Great Lakes, Tributaries, Industrial wastes, Fate of pollutants, Pesticides, DDT.

Analyses were made on composite samples of fish taken from some of the major tributaries and embayments of Lake Superior and Lake Huron for halogenated xenobiotics. A good correlation was noted between the areas of industrial and urban development and the abundance, as well as variety, of industrial pollutants and pesticides in fish. Findings suggest that Saginaw Bay acts like a sink for pollutants from the area, especially for very hydrophobic compounds that are associated with suspended matter. The major source for PBBs seems to be located around the Pine River and Chippewa River areas, while PCBs are more abundant in the Chippewa, Tittabawassee, and Flint Rivers. The PCTs seems to have sources near the Flint and Saginaw rivers and, surprisingly, in the Keweenaw Bay area. A similar pattern was noted for the PCDEs except that they were also found in the Chippewa and Tittabawasee rivers but not in the Keweenaw Bay. It is interesting to note the high concentrations of total DDTs in the Pine River and Chippewa Rivers fish, as well as the presence of DDT itself in Pine River fish, indicating a possible source for these chemicals. (Baker-IVI)
W86-01347

ACIDIFICATION OF GEORGIAN BAY RIVERS ESTIMATED BY MODIFICATIONS OF THE WRIGHT-HENRIKSEN MODEL,
Department of Fisheries and Oceans, Owen Sound (Ontario). Great Lakes Fisheries Research Branch.
M. G. Johnson.
Journal of Great Lakes Research, Vol. 11, No. 2, p 163-170, 1985. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Georgian Bay, *Ontario, *Fate of pollutants, *Acidification, Acid rain, Alkalinity, Mathematical models, Anions, Organic compounds, Sulfates, Hydrogen ion concentration.

Major ion composition of fresh waters can be used to estimate temporal changes in alkalinity and pH caused by loadings of sulfuric acid from the atmosphere. In the Georgian Bay rivers organic anions must be considered, but road salt additions are considerably more important than minor sea-salt inputs. Nineteen rivers tributary to Georgia Bay of Lake Huron were sampled at the time of spring freshet in 1980-1983, and modified versions of the Henriksen-Wright model were used to measure acidificiation of these river systems by estimating loss of alkalinity and sulfate concentrations above background sulfate levels. Spring freshet data were used to assess acidification at times of extreme conditions, which likely are of more significance to aquatic life. While seasonal variations in acidification have not been examined, springtime discharges should be more representative of the acidification stress on these systems. Alkalinity estimates, averaged for all rivers, were 107-147 micro-eq/L for various modifications and net sulfate estimates averaged 108-125 micro-eq/L. Both measures of acidification increased with proximity to Sudbury. The decrease in alkalinity, 45-166 micro-eq/L for the 19 rivers, was related to the spatial variability in atmospheric acid loadings, while the pH decrease, 0.2-1.6 units, reflected as well the original buffering of each river. Organic anions were important in achieving cation-anion balances, in interpretation of pH, and in modification of the Wright-Henriksen model. (Baker-IVI)
W86-01348

TIME-DEPENDENT SOLUTION OF MULTI-SEGMENT MASS BALANCE MODELS OF CONTAMINANTS IN THE GREAT LAKES,
Argonne National Lab., IL. Environmental Research Div.
B. M. Lesht.
Journal of Great Lakes Research, Vol. 11, No. 2, p 182-189, 1985. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Phosphorus, *Mass balance, *Great Lakes, Seasonal variations, Linear programming, Model studies, Fate of pollutants, Lakes.

The application of the time-dependent multisegment mass balance model to the phosphorus balance of the Great lakes is one example of the utility of the technique. Simple mass balance models are widely used for a variety of purposes but are often restricted by the assumption of steady state. Although this assumption reduces the amount of information required by the models it also limits the information provided by the models. Formulating the model in time-dependent terms requires more input information but also provides more detailed output. The choice between the two formulations will depend on the purpose for which the model is developed. In the case of a model being developed as a synthesis of present understanding of a complicated environmental system, the time-dependent

multi-segment mass balance model can be a valuable tool. The time dependent solution may be used to evaluate year to year variations in the system response to time variable forcing, or to determine model uncertainty due to temporal variation in the model coefficients. (Baker-IVI)
W86-01350

ATMOSPHERIC SULFUR DIOXIDE AND RAINWATER AT A COASTAL LOCALITY IN N.W. ENGLAND,
Liverpool Univ. (England). Dept. of Geography.
A. J. Wharfe, and P. A. James.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 237-242, July, 1985. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Sulfates, *Rain, *England, North Merseyside, Hydrogen ion concentration, Acid rain, Water pollution sources, Sulfur dioxide.

The relationship between atmospheric sulfur dioxide concentrations and rainwater pH is examined for a coastal locality in North Merseyside, England for the period 1978 to 1982. There were appreciable differences between pH values for the sampling sites. There was no seasonal pattern in pH which is consistent for all the years, though a tendency does exist for a summer maximum. Sulfate shows a normal winter maximum. pH correlated significantly with time as measured through the 1978 to 1982 period. The Merseyside regional average sulfate levels declined markedly during the 1960's, the rate of decline decreasing in the mid-1970's. The lessening of acidity in the rainwater between 1978 and 1982 is noted. Over this same period local sulfate levels have decreased slightly. The significance of long range pollutant transport is recognized but there is evidence to suggest that sulfate concentrations at Formby are related to wind frequency and wind run from the direction of the Merseyside and Manchester conurbations. (Baker-IVI)
W86-01352

SURVIVAL OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN WATERS,
Environmental Protection Service, Dartmouth (Nova Scotia).
A. S. Menon, and J. de Mestral.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 265-274, July, 1985. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Bacillus thuringiensis, *Nova Scotia, *Insecticides, Pesticides, Bacteria, Biocides, Path of pollutants, Drinking water, Chlorination.

In the summer of 1979 and 1980, the Nova Scotia Dept. of Lands and Forests conducted a pilot spray project on the use of Bacillus thuringiensis var. kurstaki for the control of spruce budworm infestation in Nova Scotia. Field and laboratory studies were conducted to assess the survival of B. t. var. kurstaki in waters. Lab studies showed that B. t. var. kurstaki can survive in fresh water and sea water for more than 70 and 40 days, respectively, at 20 C. A higher percentage of B. t. var. kurstaki was found surviving in lake water than in tap and distilled water for an extended period, probably due to the presence of more available nutrients in lake water for growth. B. t. var. kurstaki was found in the Parrsboro water sytem during the spray study, raising the suspicion that the amount of residual Cl normally applied to municipal drinking water supplies might not be sufficient to kill B. t. var. kurstaki. This is supported by the results of the laboratory studies that high Cl concentrations, 1.5 to 2.0 mg/L, and long contact time, 45 to 60 min, are needed to inactivate B. t. var. kurstaki completely. (Baker-IVI)
W86-01354

ACID PRECIPITATION AND SURFACE-WATER VULNERABILITY ON THE WESTERN SLOPE OF THE HIGH COLORADO ROCKIES,
California Univ., Berkeley. Energy and Resources Group.
J. Harte, G. P. Lockett, R. A. Schneider, H. Michaels, and C. Blanchard.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 313-320, July, 1985. 2 Fig, 2 Tab, 16 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Rocky Mountains, *Colorado, *Acid rain, Alkalinity, Rainfall, Alpine lakes, Watersheds, Hydrogen ion concentration.

Increased fossil fuel consumption in California, the Great Basin, or the upper or lower Colorado River drainage regions could lead to increased acidity of precipitation in the Rockies. The occurrence of acid precipitation at a remote and sensitive location in the Colorado Rockies brought about a long term study of the precipitation and surface waters of the western slope. The site is distant from highways, point sources, and major urban areas, and receives consistently acidic precipitation. The resulting data provide a means of assessing the present sensitivity of watersheds in the region to acidification and ultimately will allow determination of trends. The volume-weighted average pH for summer events was 4.61, for winter events was 5.11 and for the entire period was 4.91. Within the watershed, both low- and medium-alkalinity surface waters exist. Weekly alkalinity measurements ranged from 10 to 70 micro-eq/l in the former and 100 to 900 micro-eq in the latter. The findings demonstrate the occurrence of acid precipitation and the susceptibility to acidification of alpine lakes in this area. (Baker-IVI)
W86-01356

PARTITIONING OF HEAVY METALS (FE, MN, CD, PB, CU, ZN, CO, NI AND AS) AND P INTO SELECTIVE CHEMICAL FRACTIONS IN SEDIMENTS FROM LAKE KOJIMA (IN JAPANESE),
S. Nakashima, M. Yagi, and I. Aoyama.
Nogaku Kenkyu, Vol. 60, No. 4, p 157-169, March, 1985. 12 Fig, 13 Ref.

Descriptors: *Lake Kojima, *Okayama Prefecture, *Japan, *Lake sediments, *Heavy metals, *Phosphorus, Iron, Manganese, Cadmium, Cadmium, Lead, Copper, Zinc, Cobalt, Nickel, Arsenic, Metals, Nutrients, Particle size, Clays, Organic matter, Silicates, Sulfides.

To investigate the mechanism of metal accumulation in the sediment of Lake Kojima, Okayama Prefecture, Japan, surface sediments (10 samples) were collected and analyzed for Fe, Mn, Cd, Pb, Cu, Zn, Co, Ni, As and P. Partitioning of these metals and P into mineral and organic fractions was determined with selective chemical leaching techniques for sediment samples. Iron, Ni, and to a lesser degree, Co and As were contained in larger amounts in the silicate fraction, than in the non-silicate fractions. Arsenic, Co and Ni were concentrated mainly in the hydrous Fe/Mn oxide, sulfide and organic phases, and Fe was concentrated in the hydrous oxide and sulfide phases. The contents of Mn, Cd, Pb, Cu, Zn and P were lower in the silicate fractions than the non-silicate fractions, especially that of Cd. Manganese was fairly well distributed in all fractions, being dominant in the exchangeable, hydrous oxide and carbonate fractions. A large proportion of Cd, Pb, Cu, Zn and P was concentrated in the exchangeable (especially Cd), hydrous oxide, sulfide and organic fractions. Particularly, the contents of these elements in these four fractions were higher in sediments from the mouths of the Rivers Kurashiki and Sasagase which flow into the lake than in sediments from the lake. The contents of Mn, Cd, Pb, Cu, Zn and P in the silicate fractions were nearly the same in both fine-textured and coarse-textured sediments. Heavy metals and P in the fine-textured sediments were more highly concentrated in the hydrous oxide, sulfide and organic fractions than the coarse sediments. As a result, the total contents of these elements were higher in fine-textured than in coarse-textured sediment. These results indicate that heavy metals and P released by human activity are carried by the rivers into Lake Kojima, are adsorbed on hydrous Fe/Mn oxides and/or clay, are associated with organic matter or absorbed by living things, and are then precipitated and fixed in the sediment. (Author's abstract)
W86-01362

ASSESSMENT OF POLLUTION HISTORY FROM RECENT SEDIMENTS IN LAKE VANAJAVESI, SOUTHERN FINLAND. I. SELECTION OF REPRESENTATIVE PROFILES, THEIR DATING AND CHEMOSTRATIGRAPHY,
Helsinki Univ. (Finland). Dept. of Zoology.
P. H. Kansanen, and T. Jaakkola.
Annales Zoologici Fennici, Vol. 22, No. 1, p 13-55, 1985. 29 Fig, 8 Tab, 135 Ref.

Descriptors: *Lake sediments, *Water pollution, *Lake Vanajavesi, *Finland, Radioactive dating, Wood wastes, Heavy metals, Industrial wastes, Copper, Zinc, Cesium radioisotopes, Plutonium, Cadmium.

Surficial sediments were sampled from eutrophic Lake Vanajavesi (Finland) using 79 short sediment cores. The lake has been subjected to waste water loading for 100 years mainly from the wood processing industry. Of the analyzed heavy metals, zinc, cadmium and copper showed clear enrichment in the selected profiles. For these elements the maximum cultural enrichment factors were 84.6, 6.1, and 2.9, respectively. Zinc was the best tracer for mapping the areal distribution and for giving historical records of industrial waste waters due to the high point source loading from the chemical industry that has occurred since 1943. Dehydroabietic acid content in sediment indicated an abrupt increase since the 1940s in the loading from the wood processing industry. Due to mixing, the peak of Cs-137 and Pu-239,240 was deeper than expected on the basis of mean sedimentation rate. The time scale derived from Cs-137 and Pu-239,240 distribution was in accordance with the zinc stratigraphy and known history of zinc loading. (Baker-IVI)
W86-01365

ASSESSMENT OF POLLUTION HISTORY FROM RECENT SEDIMENTS IN LAKE VANAJAVESI, SOUTHERN FINLAND. II. CHANGES IN THE CHIRONOMIDAE, CHAOBORIDAE AND CERATOPOGONIDAE (DIPTERA) FAUNA,
Helsinki Univ. (Finland). Dept. of Zoology.
P. H. Kansanen.
Annales Zoologici Fennici, Vol. 22, No. 1, p 57-90, 1985. 12 Fig, 11 Tab, 75 Ref.

Descriptors: *Lake Vanagavesi, *Finland, *Eutrophication, *Aquatic insects, Lake sediments, Population dynamics, Midges, Water pollution effects, Eutrophic lakes.

The present midge fauna of Lake Vanajavesi (Finland) was compared to subfossil remains from sediment profiles as part of a study of the development of Lake Vanajavesi during the industrial period of its history in the 19th and 20th Centuries. In Lake Vanajavesi eutrophication has led to the replacement of an oligotrophic Microspectra - Monodiamesa community by a eutrophic Chironomus anthracinus community in the first decades of this century. The replacement took place at a relatively low leading level; about 1/10-1/15 of the present total wastewater load. This is in accord with the established fact that Vanajavesi, like many other lakes in the clay area of southern Finland, was originally eutrophic. The dysoligotrophic features are due to a high humus load. Artificial lowering of the water levels also probably adversely affected the food availability for the midge fauna. A relatively slight cultural impact was needed to cause a return of the eutrophic conditions. In the further succession from a Chironomus anthracinus community to a Chironomus plumosus community, and finally to the disappearance of the deep water fauna, the key factor appears to have been the oxygen content of the water. The oxygen state of Lake Vanajavesi depends not only on the production level of the lake, but more on the direct impact of waste water loading having a high BOD. (Baker-IVI)
W86-01366

CHANCE-CONSTRAINED/STOCHASTIC LINEAR PROGRAMMING MODEL FOR ACID RAIN ABATEMENT - I. COMPLETE COLINEARITY AND NONCOLINEARITY,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
J. H. Ellis, E. A. McBean, and G. J. Farquhar.
Atmospheric Environment, Vol. 19, No. 6, p 925-927, 1985. 8 Fig, 5 Tab, 22 Ref.

Descriptors: *Acid rain, *Statistical analysis, *Computer programs, *Linear programming, *Model studies, Sulfur dioxide, Fate of pollutants, Path of pollutants, Water pollution prevention.

A Linear Programming model is presented for development of acid rain abatement strategies in eastern North America. For a system comprising of 235 large controllable point sources and 83 uncontrolled area sources, it determines the least-cost method of reducing SO2 emissions to satisfy maximum wet sulfur deposition limits at 20 sensitive receptor locations. The purely deterministic model is extended to a probabilistic form by incorporating the effects of meteorologic variability on the long-range pollutant transplant processes. These processes are represented by source-receptor-specific transfer coefficients. Experiments for quantifying the spatial variability of transfer coefficients showed their distributions to be approximately lognormal with logarithmic standard deviations consistently about unity. Three methods of incorporating second-moment random variable uncertainty into the deterministic LP framework are described: Two-Stage Programming Under Uncertainty (LPUU), Chance-Constrained Programming (CCP) and Stochastic Linear Programming (SLP). A composite CCP-SLP model is developed which embodies the two-dimensional characteristics of transfer coefficient uncertainty. Two probabilistic formulations are described involving complete colinearity and complete noncolinearity for the transfer coefficient covariance-correlation structure. Complete colinearity assumes complete dependence between transfer coefficients. Complete noncolinearity assumes complete independence. The completely colinear and noncolinear formulations are considered extreme bounds in a meteorologic sense and yield abatement strategies of largely didactic value. Such strategies can be characterized as having excessive costs and undesirable deposition results in the completely colinear case and absence of a clearly defined system risk level (other than expected-value) in the noncolinear formulation. (Author's abstract)
W86-01381

AEROSOL CHEMISTRY IN MINNESOTA AND WISCONSIN AND ITS RELATION TO RAINFALL CHEMISTRY,
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2K.
W86-01382

CHEMICAL ZONATION IN GROUNDWATER OF THE CENTRAL PLAINS, CANTERBURY,
North Canterbury Catchment Board, Christchurch (New Zealand).
R. J. Burden.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 100-119, 1984. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Central Plains, *Groundwater, *New Zealand, *Nitrates, Zones, Land use, Chlorides, Water pollution sources, Groundwater pollution, Leaching, Fertilizers, Pastures, Wastewater pollution.

The relationship between land use and nitrate levels in Central Plains (New Zealand) groundwater was studied. The principal sources of nitrate are quantified and the movement and accumulation of nitrate in groundwater are described. Groundwater samples were obtained from about 600 wells over the period 1977 to 1983. Major ion analyses were conducted on water from about 300 wells in the specific study area, mostly located near Christchurch City or near suspected point sources of contamination. The remainder were analyzed for both nitrate and chloride or nitrate alone. The Central Canterbury Plains consist of a vertical sequence of coalesced glacial outwash and postglacial alluvial fans deposited by the Rakaia, Selwyn and Waimakariri Rivers. Several sources contribute to nitrate concentrations in Central Plains groundwater. Dryland pasture is the principal source of nitrate affecting the quality of the groundwater. Cropping is widespread on the deeper soils on the Plains with the amount of nitrate leached from cropland being dependent on soil depth and the timing of irrigation and fertilizer applications. Domestic and industrial sewage from most of the Christchurch metropolitan area and from Lincoln township is disposed, via treatment plants, to surface water and therefore does not affect groundwater quality. The major point sources of waste and irrigated animal effluent together contribute only about 5% of the total nitrate load in Central Plains groundwater. The groundwater has been divided into three chemical zones. Zone 1 lies in regions of recharge from rivers; 2 includes unconfined and semi-confined groundwater down to 60 m below the water table, and some shallow confined groundwater, and 3 comprises all deep circulating groundwater. (Baker-IVI)
W86-01387

PREDICTION OF CHARACTERISTICS FOR VERTICAL ROUND BUOYANT JETS IN STABLY LINEAR STRATIFIED ENVIRONMENT,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
For primary bibliographic entry see Field 8B.
W86-01392

COPPER DISSOCIATION FROM ESTUARINE HUMIC MATERIALS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. L. Olson, and M. S. Shuman.
Geochimica et Cosmochimica Acta, Vol. 49, No. 6, p 1371-1375, 1985. 5 Fig, 2 Tab, 37 Ref. NSF grant OCE-7914592.

Descriptors: *Kinetics, *Copper, *Humic acids, *Estuarine environment, Metals, Chemical reactions, Organic matter, Chemical kinetics.

The kinetics of Cu-organic binding in an estuary is examined. Previous data analysis methods have been extended by developing a nonlinear kinetic model for the simultaneous, first order dissociation reactions of CuHM (Cu humic material). The model gives a kinetic spectrum which is used to examine how CuHM rate constants are distributed among bound Cu(II) and how they vary with molecular size and sampling site along a southeastern U.S. estuary. A significant portion of bound Cu(II), 28-54%, reacted with $k > 40$/sec. In general, variations were observed only between size fractions. Since a major portion of Cu(II) bound to HM is labile, it cannot be generally assumed that dissociation is so slow that complexes can be separated from free metal without disturbing the Cu(II)-HM equilibrium. The kinetic spectrum model, described as a set of independently and simultaneously reacting Cu(II) binding sites, can easily accommodate an unknown number of components and a wide range of constants. These features are critical for valid application to a metal-HM kinetic system and interpretation of data. The model also provides a means of optimizing the time range of kinetic measurements by inspection of preliminary data. (Baker-IVI)
W86-01395

PARTITIONING AND TRANSPORT OF METALS ACROSS THE O2/H2S INTERFACE IN A PERMANENTLY ANOXIC BASIN: FRAMVAREN FJORD, NORWAY,
Washington Univ., Seattle. School of Oceanography.
L. Jacobs, S. Emerson, and J. Skei.
Geochimica et Cosmochimica Acta, Vol. 49, No. 6, p 1433-1444, June, 1985. 7 Fig, 6 Tab, 23 Ref. NSF grant OCE 82-13927-1.

Descriptors: *Metals, *Transport, *Framvaren Fjord, *Norway, Anoxic conditions, Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Cadmium, Solubility, Sulfides, Marine waters.

The zonation of geochemical processes operating in anoxic basins provides a unique opportunity to weigh their relative importance in the solid aqueous phase partitioning and transport of metals across the O2/H2S interface. Water samples and suspended particulates were collected from Framvaren Fjord, Norway. The metals Mn, Fe, Co Ni, Cu, Zn, and Cd showed systematic variations in their response to the processes of metal sulfide precipitation and metal oxide O2/H2S interface cycling. For manganese sulfide a nearly constant ion activity product (IAP) is maintained throughout the water column. The calculated manganese sulfide IAP is undersaturated with respect to known pure phases, however, the existence of manganese as a trace component in framboidal pyrite (1%) may explain this undersaturation if solid solution equilibrium is assumed. Transition metals show involvement in both metal sulfide formation and metal oxide interface cycling. The intensity of this cycling is quantified with a box model, with the resulting hierarchy: Mn>Co>Fe>Ni. The Class B metals show no involvement in interface cycling and strong involvement in metal sulfide precipitation. The abrupt concentration drop across the O2/H2S interface observed for copper, zinc and cadmium translates to a residence time of one year for these metals in the oxic surface water. Surface concentrations and the common transport mechanism described for copper, zinc and cadmium are directly coupled to the sediment enrichments (relative to the lithogenic component) observed for these metals, suggesting that anoxic basins act as excellent Class B metal traps. The source of the sediment excess could be explained by atmospheric fallout for cadmium and zinc. (Baker-IVI)
W86-01396

ORGANOCHLORINE CHEMICAL RESIDUES IN WHITE PELICANS AND WESTERN GREBES FROM THE KLAMATH BASIN, CALIFORNIA,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 5C.
W86-01409

SODIUM IN DRINKING WATER IN SOUTH CAROLINA,
South Carolina State Dept. of Health and Environmental Control, Columbia. Div. of Chronic Disease.
For primary bibliographic entry see Field 5C.
W86-01411

FACTORS CONTROLLING PHOSPHORUS LIMITATION IN STREAM SEDIMENTS,
State Univ. of New York Coll. at Cortland. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W86-01417

COMPARISON OF TWO MODELS FOR PREDICTING RIVER WATER QUALITY,
Birmingham Univ. (England). Dept. of Civil Engineering.
C. F. Foster, R. W. Crabtree, C. P. Crockett, and I. D. Cluckie.
Effluent and Water Treatment Journal, Vol. 25, No. 5, p 161-164, May, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Model studies, *River flow, *Water quality control, Qual-II, Blackwater River, England, Water management, Flow, Dissolved oxygen, Ammonia, Nitrogen.

The two models which are examined include a general purpose model (Qual-II) and one which is river-specific. Each model was applied to the River Blackwater in order to make the comparison. The river specific model was developed to predict the possible effects of population and waste treatment changes in the Blackwater catchment (England). It is one dimensional and operates in a steady-state mode, although dissolved oxygen changes due to photosynthesis are modelled as on steady state, due to diurnal variation in light inten-

sity. The model requires an input of calculated hydraulic relationships for each reach as well as the relative plant density for each reach. The model is based on field work derived constants. The input requirements for Qual-II are 28 constants plus 16 parameter values for system identification. Neither model gave a perfect prediction. The results for Qual-II showed that the best modelled variables were BOD and ammoniacal nitrogen, followed by DO and nitrate-nitrogen. The order for the Blackwater model was ammoniacal nitrogen and BOD followed by DO and nitrate nitrogen. The fact that Qual-II gave better results for BOD, DO and nitrate-nitrogen but was slightly worse for ammoniacal-nitrogen, may be due to Qual-II using interactions with algal growth rather than Nitrosomonas bacteria. Although the major difficulty in applying either model to this river system was the availability of sufficient hydraulic data, particularly travel times, the regular use of Qual-II in the United Kingdom could be of real benefit to resource management on a catchment basis. (Baker-IVI)
W86-01438

HEAVY METAL OCCURRENCE AND GEOCHEMICAL FRACTIONATION: THE RELATIONSHIPS OF CATCHMENT SOILS TO ASSOCIATED ESTUARINE SEDIMENTS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
M. A. Badri, and S. R. Aston.
Environmental Pollution (Series B), Vol. 10, p 61-75, 1985. 2 Fig, 8 Tab, 19 Ref.

Descriptors: *Heavy metals, *Path of pollutants, *Soils, *Estuarine sediments, Goechemistry, Leaching, Iron, Manganese, Cadmium, Copper, Lead, Zinc, Catchment area, England, Particle size.

There are several pathways by which metals from the catchment soils can eventually be removed for the soil matrix and deposited into the receiving estuarine system; data from this study indicate the possibility of a natural leaching process. Catchment soils and surface sediments from the associated estuary in Northwest England were analyzed for total Fe, Mn, Cd, Cu, Pb and Zn and the distribution of these metals between geochemical fractions. Three types of heavy metal analysis were performed: total concentrations, the concentrations in the non-residual fraction and the concentration in the exchangeable fraction. In general, metal behaviors in the catchment soils and estuarine surface sediments are different, with soils showing greater leaching tendency than sediments. For the soils, considerable variations in total metal and non-residual concentrations were found at different localities, while the same metal fractions in the sediments were uniformly distributed. The observed variations are not dependent on simple grain size distributions. The strong Cd/Mn association in terms of leachability indicates a potential for long-term release of Cd to the overlying waters. (Moore-IVI)
W86-01454

'MIXING-CELL' CONCEPT APPLIED TO TRANSPORT OF NON-REACTIVE AND REACTIVE COMPONENTS IN SOILS AND GROUNDWATER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. C. Van Ommen.
Journal of Hydrology, Vol. 78, No. 3/4, p 201-213, June, 1985. 9 Fig, 2 Tab, 12 Ref.

Descriptors: *Path of pollutants, *Soil water, *Solute transport, Groundwater pollution, Mathematical equations, Tracer studies, Convection, Diffusion.

The one-dimensional stationary transport of a component is described and the relation between time step, cell size and flow velocity is derived. The mixing-cell concept is applied to a two-dimensional transport problem and the results are compared to other experimental work. It is concluded on the basis of a comparison between the analytical solution of the convection/diffusion-equation in one dimension and a solution provided by the mixing-cell concept that the latter applied to a two-dimensional groundwater quality problem gives a fair description of the experimentally obtained breakthrough curves and opens perspectives concerning the description of transport of reactive solutes in groundwater. Its simplicity, as compared to other methods, is attractive. (Baker-IVI)
W86-01469

ESTIMATING INTERFACE ADVANCE DUE TO ABRUPT CHANGES IN REPLENISHMENT IN UNCONFINED COASTAL AQUIFERS,
Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-01474

LONGITUDINAL DISPERSION IN A FOREST STREAM,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Dept. des Sciences du Sol.
C. Legrand-Marcq, and H. Laudelout.
Journal of Hydrology, Vol. 78, No. 3/4, p 317-324, June, 1985. 2 Fig, 14 Ref.

Descriptors: *Streams, *Dispersion, *Path of pollutants, Solute transport, Stream pollution, Differential equations, Stagnant water, Streamflow.

A forest stream typical of those found in SE Belgium and NE France has been studied with respect to the parameters determining the dispersion of a non-reactive solute in a streamflow with stagnant zones. Non-linear adjustment of an analytical solution of two partial differential equations describing longitudinal dispersion and solute exchange between main stream and stagnant water provided a set of parameters describing satisfactorily the experimental results. The dead-zone fraction diminished very rapidly as soon as the flow rate increased beyond a fairly low value and remained constant thereafter. The longitudinal dispersion coefficient followed an inverse pattern but in a somewhat less regular way. Attempts were made to correlate these changes with the Darcy-Weisbach friction factor. (Author's abstract)
W86-01476

DEGRADATION AND MINERALIZATION OF THE POLYCYCLIC AROMATIC HYDROCARBONS ANTHRACENE AND NAPHTHALENE IN INTERTIDAL MARINE SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. E. Bauer, and D. G. Capone.
Applied and Environmental Microbiology, Vol. 50, No. 1, p 81-90, July, 1985. 6 Fig, 6 Tab, 30 Ref. EPA grant R809475011, NOAA grant NA-80-RAD00057, Hudson River Foundation grant 14/83B/12.

Descriptors: *Polycyclic aromatic hydrocarbons, *Anthracene, *Naphthalene, *Degradation, *Mineralization, *Marine sediments, Intertidal zone, Biodegradation, Acclimatization, Fate of pollutants, Aromatic compounds, Hydrocarbons, Microorganisms, Dissolved oxygen, Temperature effects.

The degradation of the polynuclear aromatic hydrocarbons (PAHs) anthracene and naphthalene by the microbiota of intertidal sediments as investigated in laboratory studies. No mineralization of either PAH was observed in the absence of oxygen. Both rates and total amounts of PAH mineralization were strongly controlled by oxygen content and temperature of the incubations. Inorganic nitrogen and glucose amendments had minimal effects on PAH mineralization. The rates and total amounts of PAH mineralized were directly related to compound concentration, pre-exposure time, and concentration. Maximum mineralization was observed at the higher concentrations (5 to 100 micro-g/g) of both PAHs. Optimal acclimation to anthracene and naphthalene (through pre-exposures to the compounds) occurred at the highest acclimation concentration (1,000 ppm). However, acclimation to a single concentration (100 ppm) resulted in initial relative mineralization rates over a range of re-exposure concentrations (1 to 1,000 ppm) being nearly identical. Maximum mineralization of both PAHs occurred after intermediate periods (1 to 2 weeks) of pre-exposure. The fraction of the total heterotrophic population capable of utilizing anthracene or naphthalene as sole carbon source was also greatest after 2 weeks. (Author's abstract)
W86-01481

RESPONSE OF THE MICROFLORA IN OUTDOOR EXPERIMENTAL STREAMS TO PENTACHLOROPHENOL: COMPARTMENTAL CONTRIBUTIONS,
Connecticut Agricultural Experiment Station, New Haven.
J. J. Pignatello, L. K. Johnson, M. M. Martinson, R. E. Carlson, and R. L. Crawford.
Applied and Environmental Microbiology, Vol. 50, No. 1, p 127-132, July, 1985. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Pentachlorophenol, *Microbial degradation, *Fate of pollutants, Stream pollution, Dissolved oxygen, Chlorinated phenols, Substrates.

Outdoor artificial streams were treated continuously with pentachlorophenol (PCP) for 88 days during the summer of 1983. The contributions of different stream compartments (microbial habitats) to microbial degradation of PCP were determined in a stream treated with 144 micro-g of PCP per liter. The 488-m long stream was composed of mud-bottomed pools alternating with gravel riffles. PCP loss in the stream attributable to microbial degradation after an adaptation period was in the range of 55 to 74%. Contributions to PCP loss were determined for rock surface (epilithic), macrophyte surface (epiphytic), sedimentary, and water column communities by measuring rates of PCP disappearance in stream water, containing ambient concentrations of PCP, in contact with representative compartmental samples. The specific capability, in units of micrograms of PCP per hour per square meter of stream cross-sectional area (macrophytes at maximum plant density, water column at mean depth, upper 10-cm layer of gravel), followed the order rock surface > macrophytes > sediment approximately = water column. The compartmental contribution to total stream losses in units of grams per hour followed the same order, although the differences were smaller. The rate of PCP disappearance in the water column above sediment cores followed the order oxygen-rich > oxygen-poor approximately = anaerobic > sorption-only conditions. The large difference in specific capability between the rock surface and sediment compartments could be attributed to oxygen deficiency (because of chemical and biological oxygen demand) in the sediments. Free-floating and particle-attached organisms in the water column were important to PCP biodegradation. (Author's abstract)
W86-01483

ACID RAIN: DOUSING COMMUNITY RESOURCES,
For primary bibliographic entry see Field 5G.
W86-01488

WATER QUALITY IN AN ESTUARINE ENVIRONMENT: ANNUAL CYCLE OF THE PHYSICAL AND CHEMICAL PARAMETERS OF THE WATER OF THE LOIRE ESTUARY (QUALITE DES EAUX EN MILIEU ESTUARIEN: SUIVI ANNUEL DE CRITERES PHYSIQUES ET CHIMIQUES DANS LES EAUX DE L'ESTUAIRE DE LA LOIRE),
Nantes Univ. (France). Lab. de Biologie Marine.
For primary bibliographic entry see Field 2L.
W86-01505

ESTIMATES OF AVERAGE MAJOR ION CONCENTRATIONS IN BULK PRECIPITATION AT TWO HIGH-ALTITUDE SITES NEAR THE CONTINENTAL DIVIDE IN SOUTHWESTERN COLORADO,
Geological Survey, Lakewood, CO.

M. M. Reddy, and H. C. Claassen.
Atmospheric Environment, Vol. 19, No. 7, p 1199-1203, 1985. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Precipitation chemistry, *Altitude, *Colorado, Calcium, Sulfates, Nitrates, Seasonal variation, Atmospheric deposition.

The composition of bulk precipitation from two high-altitude sites, established in 1971 near the Continental Divide in southwestern Colorado, has been monitored by season during the past decade. Calcium ions are the predominant cationic species; sulfate is the major anionic constituent. Bulk precipitation major ion concentrations exhibit log-normal distributions. Representative mean and standard deviation values for the major inorganic ionic species present in bulk precipitation have been calculated for three years of consecutive seasons. Standard deviations for all species, except nitrate, are similar. For two years of data grouped into quarters, deviations from mean values fall well within the plus or minus two standard deviation limit. There does not seem to be a systematic deviation from the mean concentration values, with respect to either ionic component or season. (Author's abstract)
W86-01515

LEVELS OF HEAVY METALS IN THE TIDAL ELBE AND ITS ESTUARY AND THE HEAVY METAL INPUT INTO THE SEA,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
L. Mart, H. W. Nurnberg, and H. Rutzel.
Science of the Total Environment, Vol. 44, No. 1, p 35-49, July, 1985. 10 Fig, 2 Tab, 25 Ref. Federal Minister of Research and Technology (Bonn) contract MT 405 g/Aut 03, EEC contracts 173/77 ENVD ENVD690-D.

Descriptors: *Heavy metals, *Elbe River, *Estuaries, *Germany (Federal Republic), Water pollution, Copper, Cadmium, Lead, Nickel, Cobalt, Resuspension, Turbidity, Fate of pollutants.

Surface water samples were collected during missions in 1977, 1978, 1980 and 1983 at different sampling stations along the tidal Elbe, from river km 632 downstream from Hamburg to the outer end of the estuary. Special care was taken to minimize contamination during sampling, handling and analysis. Within the tidal Elbe five distinct zones of substantial anthropogenic heavy metal pollution inputs can be detected. An attempt is made to define anthropogenic background levels, which are extremely low for the dissolved trace metals Cd and Pb; 35 and 65 ng/kg, respectively. The level of dissolved Cu is 2200 ng/kg. Total baseline levels of Cd, Pb and Cu are, respectively, 120, 2500 and 4200 ng/kg. In the five river zones affected by anthropogenic trace metal inputs, distinctly larger maximum levels can occur. They decrease to the background values after mixing with the main water body. More elevated levels caused by re-suspension in the mixing zone with maximum turbidity can be assumed. Nickel and Co data are from one mission only. The order of magnitude of the trace metal input from the Elbe into the sea is evaluated. (Author's abstract)
W86-01516

FATE OF THE PYRETHROID INSECTICIDE DELTAMETHRIN IN SMALL PONDS: A MASS BALANCE STUDY,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, G. P. Rawn, and N. P. Grift.
Journal of Agriculture and Food Chemistry, Vol. 33, No. 4, p 603-609, July/August, 1985. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Insecticides, *Deltamethrin, *Ponds, Fish, Plants, Aquatic plants, Degradation products, Sediments, Water analysis, Pyrethrins.

A quantitative determination was made of the relative importance of various pathways of pollutants such as volatilization, degradation in water and sediment, and uptake by fish and plants, following application of C-14 labeled deltamethrin to water under field conditions. A single application of the insecticide was made at 10 g/ha to two small outdoor ponds, 17 sq m in surface area. Initial concentrations of the insecticide in filtered water ranged from 1.28 to 2.50 microg/L. Deltamethrin rapidly partitioned into suspended solids, plants, sediment, and air, with a half life of 2-4 hr in water. Duckweed and a submerged pondweed accumulated deltamethrin concentrations ranging from 253 to 1021 ng/g, respectively, at 24 hr posttreatment. Sediments were the major sink for radioactivity at 306 days posttreatment, and intact deltamethrin was present at concentrations ranging from 3 to 5 ng/g. Deltamethrin levels in air above the water ranged from 10-100 ng/cu m during a 48 hr monitoring period following application. Fathead minnows accumulated levels of extractable radioactivity 248-907-fold higher than concentrations in water at 24 hr posttreatment, but no fish mortality was observed. (Baker-IVI)
W86-01526

SURVEY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FISH FROM THE GREAT LAKES AND SELECTED MICHIGAN RIVERS,
Food and Drug Administration, Detroit, MI. Pesticide and Industrial Chemical Research Center.
N. V. Fehringer, S. M. Walters, R. J. Kozara, and L. F. Schneider.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 4, p 626-630, 1985. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Great Lakes, *Michigan, *Rivers, *Pesticide residues, *Tetrachlorodibenzo-p-dioxin, Saginaw Bay, Lake Huron, Tittabawassee River, Lake Ontario, Dioxin.

Residues of 2,3,7,8-tatrachlorodibenzo-p-dioxin (TCDD) were measured in fish taken from the Great Lakes. Fish from the Saginaw Bay (Lake Huron), the Tittabawassee River in Michigan, and Lake Ontario contained the highest levels of contamination. No TCDD residues at or above the minimum confirmable level of 10 ppt were found in fish from Michigan rivers other than the Tittabawassee. Comparison of the current findings with the results of an earlier study, 1983, suggests a decrease in residue levels with time. Detectable levels of TCDD were found only in carp, catfish, salmon, white perch and trout. No residues at or above the 10 ppt level were found in sucker, whitefish, yellow perch, walleye, bullhead, crappie, bowfin, rockbass, buffalo, white bass, and sheepshead. (Baker-IVI)
W86-01527

EXCHANGE OF WATER IN FJORDS: THE EFFLUX/REFLUX THEORY OF ADVECTIVE REACHES SEPARATED BY MIXING ZONES,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W86-01536

SOME CONSIDERATIONS IN MODELING THE FATE AND TRANSPORT OF TOXICANTS IN SURFACE WATER SYSTEMS,
Lawler, Matusky and Skelly Engineers, Pearl River, NY.
J. P. Lawler.
Northeastern Environmental Science, Vol. 3, No. 2, p 90-123, 1984. 3 Fig, 31 Ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Martin Creek Lake, *Texas, Selenium, Chlorine, Polychlorinated biphenyls, Metals, Chlorinated hydrocarbons.

Simple, analytical models provide a basis for conceptualizing the important physical, chemical, and biological mechanisms that control the fate and transport of toxic substances in surface water sytems. Mechanisms influencing fate and transport of pollutants in three case studies are described through the use of this modeling approach. In all three studies, the models were employed to provide initial insights to the issues to be addressed. The total selenium concentrations in the water and sediments of Martin Creek Lake (Tatum, Texas) caused by discharges from a lignite-fired steam electric generating station were estimated and the potential effects of these concentrations on the biota of Martin Creek Lake were evaluated. Simple, analytical models were employed to provide insights to the chlorine decay process; these results were then utilized to modify several complex numerical solution computer models of hydrodynamic and conservative water quality behavior to include chlorine decay processes. Simple models of the sorption-desorption process were employed to outline a research proposal for investigation of these processes as they influence polychlorinated biphenyl (PCB) fate and transport in the Hudson River (New York). Levels of certainty and precision in understanding will depend on the quality and extensiveness of the data and the extent of refinement in the model equations; however, in the absence of extensive data or model refinement, much can be learned conceptually and directionally by utilizing the approach of the simple, analytical model. (Collier-IVI)
W86-01552

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PCB PROBLEM: A REVIEW,
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
K. E. Limburg.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 122-136, 1984. 8 Fig, 4 Tab, 50 Ref.

Descriptors: *Environmental impact assessment, *Environmental effects, *Polychlorinated biphenyls, *Hudson River, *New York, Chlorinated hydrocarbons, Fate of pollutants, Path of pollutants, Model studies, Dredging, Estuarine environment.

Despite a general agreement to deal with the Hudson River (New York) PCB problem as rapidly as possible following the 1976 PCB Settlement, remedial action planning has spanned more than eight years. During this period, monitoring, field observation, and experimental work have created an extensive data base for temporal trend analysis. The emerging trends change or modify what was previously understood about PCB dynamics in the Hudson ecosystem, and a review is provided. The original estimate of PCBs released into the Hudson (150 tons) is now thought to be low by a factor of 2.5. PCBs have been declining in the system as they solubilize, volatilize, enter the biota, and wash out. Volatilization may be a more important avenue of escape than previously suspected, as evidenced by a marked decline in lower-chlorinated forms. A second major issue concerns the physical transport mechanisms for PCBs, and two alternative models have been proposed but not validated. The issue of transport has critical management implications, for if one of the proposed mechanisms is the correct one, then dredging of the Thompson Island pool (River Mile 190) could potentially remove the source of most PCB contamination of the estuary. The impact of PCBs was examined in terms of what has been learned about fate, transport, and effects of these substances. (Author's abstract)
W86-01553

HUDSON RIVER PCB RELATIONSHIPS BETWEEN RESIDENT FISH, WATER AND SEDIMENT,
New York State Dept. of Environmental Conservation, Albany.
For primary bibliographic entry see Field 5C.
W86-01554

POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER: THE VALUE OF INDIVIDUAL PACKED-COLUMN PEAK ANALYSIS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5A.
W86-01556

PCB TRANSFORMATIONS IN UPPER HUDSON SEDIMENTS,
General Electric Co., Schenectady, NY. Research and Development Center.
J. F. Brown, R. E. Wagner, D. L. Bedard, M. J. Brennan, and J. C. Carnahan.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 166-178. 2 Fig, 6 Tab, 3 Ref.

Descriptors: *Polychlorinated biphenyl, *Fate of pollutants, *Hudson River, *New York, *Sediments, Chlorinated hydrocarbons, Path of pollutants, Sediment transport, Biodegradation, Bacteria, Anaerobic bacteria, Degradation, Congeners.

Capillary gas chromatography and mass spectrometry have been used to characterize the PCB congener distribution patterns in: (a) the commercial Aroclors discharged into the upper Hudson, (b) Aroclor specimens altered by bidegradation by microbial cultures isolated from upper Hudson sediments or by water-extraction, and (c) environmental PCB specimens recovered from upper Hudson fish or sediments. The top layers of the sediments were found to contain at least two classes of aerobic bacteria capable of oxidatively biodegrading PCBs. The commonest of these, represented by Corynebacterium sp MBI attack PCB molecules having unsubstituted 2,3 (or 5,6) positions. The second most commonly encountered aerobic group, represented by Alcaligenes eutrophus HB50, attacks those PCBs having open 3,4 (or 4,5) positions. The modest changes in PCB congener distribution pattern (from that of Aroclor 1242) exhibited by most of the surface sediments, and the larger changes exhibited by the fish, appeared generally more similar to those effected by the first of these two aerobic bacterial groups. Totally different PCB congener distribution patterns were exhibited by the lower layers of the sediments. These patterns indicated that the PCBs there were being reductively dechlorinated, probably by several different populations of anaerobic bacteria, to give several distinguishable distributions of dechlorination products. These products consisted mainly of mono- and dichlorobiphenyls, which are readily biodegradable. Every significant congeneric constituent of the Aroclor 1242 discharged into the upper Hudson was found to be degradable by one or more of the oxidative or reductive agents detected in the Hudson environment. (Author's abstract)
W86-01557

PERSISTENCE OF PCB COMPONENTS IN SEDIMENTS OF THE LOWER HUDSON,
Lamont-Doherty Geological Observatory, Palisades, NY.
R. F. Bopp, H. J. Simpson, B. L. Beck, and N. Kostyk.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 179-183. 8 Fig, 1 Tab, 7 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Hudson River, *Fate of pollutants, Degradation, Chlorinated hydrocarbons, Congeners, Chromatography.

In contrast to recent findings in the upper Hudson (New York), no evidence was found of significant PCB congener alteration in sediments of the lower Hudson. In the lower Hudson, chromatograms of extracts of sediments that have been buried for up to twenty years are very similar to chromatograms of the most used commercial PCB mixtures, while extracts of subsurface samples of the upper Hudson sediments often have compositions totally unlike any commercial PCB mixture. Both of these observations are clearly demonstrated by an examination of PCB standard and sediment extract chromatograms. Analysis of capillary chromatograms provides no evidence that significant degradation of specific PCB congeners occurs in the sediments of the lower Hudson. (Author's abstract)
W86-01558

TRANSPORT OF PCB IN HUDSON RIVER BEDLOAD SEDIMENTS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
T. F. Zimmie.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 190-196. 5 Fig, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Fate of pollutants, *Bed load, *Hudson River, *Sediment transport, Chlorinated hydrocarbons, Path of pollutants, Particle size.

In order to measure the transport of a contaminant on river sediments, the sediment transport relations must be determined. In this project, bedload sediment transport in the upper Hudson River was first determined. The bedload samples were analyzed for PCB concentrations, which enabled the determination of PCB transport via the bedload sediments. This is one of a very few investigations that deal with the transport of a toxic contaminant via bedload sediments. Two different types of bedload samplers were utilized: the Helley-Smith bedload sampler, which is a sampler often used by the U.S. Geological Survey; and a Bogardi type bedload sampler, which was developed for studies in New York State rivers and steams. The two samplers complemented each other, and it was possible to obtain satisfactory bedload samples at all times, even under extreme flood flow conditions. During the study period, a wide range of flows were encountered in the Hudson River, enabling the determination of a very satisfactory bedload sediment-discharge relationship. The PCB transport-discharge relation does not correlate as well as the sediment-discharge relation, but this is as expected. The various size fractions of the bedload samples were analyzed for PCB and percent volatiles. There was no correlation between PCB concentration and grain size. However, there was a tendency for higher PCB concentrations to occur in the larger sizes, the opposite of what one might expect. This is attributed to the organics in the sediments, a conclusion borne out by the observation that PCB concentration correlates well with percent volatiles. (Author's abstract)
W86-01560

TRENDS IN PCB TRANSPORT IN THE UPPER HUDSON RIVER,
Lawler, Matusky and Skelly Engineers, Pearl River, NY.
G. Apicella.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 196-201. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Fate of pollutants, *Sediments, Chlorinated hydrocarbons, Sediment transport, River flow, Model studies, Water pollution sources.

Because of the high affinity of polychlorinated biphenyls (PCBs) for sediment, PCB movement is controlled essentially by the hydraulic changes that affect sediment transport. The transport of PCBs was analyzed for the Upper Hudson River (New York) based on data collected by the U.S. Geological Survey (USGS) from 1976 to 1983 - the period following the major abatement of PCB discharges. Data for temporal trends in PCB concentration at Waterford, New York, were analyzed while accounting for the year-to-year variability in observed flows. A linear regression of PCB concentration vs flow was made using data that are separated into low- and high-flow ranges, that is, below and above 10,000 cfs. The regressions account for the dependence of PCB concentration on the flow at the time of the sampling and enables a comparison among years of PCB data that are normalized for flow. Decreases in PCB concentration over time are found for both flow ranges, suggesting that the riverbed source releases diminishing amounts of PCB to the overlying water. A multiple regression analysis was conducted with PCB concentration as the dependent variable and flow, time, and suspended sediment concentration as candidate independent variables. Results of this analysis confirm a significant trend toward decreasing PCB concentration with time. In addition to time, river flow is a second factor in determining PCB concentration. Suspended sediment concentration does not improve the regression equation significantly because its effect essentially duplicates that of flow, which is already included. An analytical framework for evaluating PCB transport through the Upper Hudson River was developed based on previously collected data. Evaluation procedures comprise extending the analyses of Waterford data to other sampling stations and integrating river flow, which has a long-term cycle of 20 years, into the computation of PCB transport. The effect of the cycle - which will soon enter a phase of generally increasing flow - on the driving force on PCB transport can be evaluated using these analytical approaches. (Author's abstract)
W86-01561

PCB TRANSPORT IN THE FT. EDWARD AREA,
New York State Dept. of Environmental Conservation, Albany.
T. J. Tofflemire.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 203-208. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Fort Edwards, *Sediments, *River beds, Chlorinated hydrocarbons, Organic carbon, Fate of pollutants, Path of pollutants, Water pollution sources.

Removal of the Ft. Edwards dam on the Hudson River (New York) in 1973 exposed coarse trashy sediment containing polychlorinated biphenyls (PCBs) and other contaminants. The fate of PCBs in the Ft. Edward area was analyzed with data on river water transport, air transport and dredging transport. The water transport of PCB's at Roger's Island is decreasing with time, although a small unidentified source of PCB north of Area 1 of the remnant deposits may still be present. From water sampling studies at low flow, it was shown that only 25% of the PCB's passing Rogers Island were coming from the east bank or channel. About 40% of the PCB's were coming from sources north of Area 1, with the remainder coming from the broad river bottom areas which are mostly rock. These upstream sources should be located an sampled by some type of integrating and concentrating systems that integrate PCB from water over several weeks. The remnant deposits appear to be scouring much less than before 1979. PCBs have been volatilizing from the remnant deposit sediments; air PCB values over the remnant areas are decreasing with time. The last sampling was in 1982. Depletion of PCB from the surface layer and the build up of organic carbon in the top soil due to increased vegetation on Areas 4 and 5 probably aids this process. (Collier-IVI)
W86-01562

EFFECTS OF DREDGING OPERATIONS ON NUTRIENT AND SUSPENDED SEDIMENT CONCENTRATIONS,
Army Engineer District, New York.
J. F. Tavolaro, and J. M. Mansky.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 208-216. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Dredging, *Nutrients, *Suspended sediments, *Raritan Bay, *New York Bay, *New Jersey, Source of pollutants, Nitrates, Environmental effects, Ammonia, Phosphates.

In response to concerns about the potential impact of dredging operations to water quality, two monitoring efforts were undertaken. Concentrations of dissolved nutrients were monitored for hopper dredging operations in Raritan Bay, NY/NJ and concentrations of suspended sediment were monitored for clamshell dredging operations in the Upper Bay of New York Harbor. Concentrations of TKN, nitrate and total ammonia did not appear to be affected in the vicinity of the dredging. Total phosphate and orthophosphate appeared to decrease while nitrite appeared to increase, although the overall nitrite concentrations were low. Flumes of higher than ambient concentrations of suspended sediment did not persist more than 24 hours after dredging ceased. Maximum concentration ranged from several hundred milligrams per liter on the bottom to less than 100 mg/l on the surface within 60 meters of the dredge. Surface and bottom concentrations decreased rapidly with distance from the dredge and ranged from 20 to 30

mg/l at a distance between 210 meters and 350 meters. Ambient conditions were established within 480 meters on the surface and 570 meters on the bottom. (Author's abstract)
W86-01563

ORIGIN OF HIGH CADMIUM CONCENTRATIONS IN HUDSON RIVER BLUE CRAB (CALLINECTES SAPIDUS RATHBUN),
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
For primary bibliographic entry see Field 5C.
W86-01565

BACKGROUND LEVELS OF DISSOLVED/DISPERSED PETROLEUM RESIDUES IN THE GULF OF ST. LAWRENCE, 1970-79,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
E. M. Levy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 544-555, March, 1985. 3 Fig, 8 Tab, 16 Ref.

Descriptors: *Gulf of St. Lawrence, *St. Lawrence Estuary, *Saguenay Fjord, *Water pollution sources, *Path of pollutants, *Hydrocarbons, Model studies, Fate of pollutants, Monitoring, Mixing.

A 10-yr program of monitoring the incidence and distribution of dissolved/dispersed petroleum residues in the Gulf of St. Lawrence confirmed that the major source is the Atlantic water that enters through Cabot Strait and demonstrated that a substantial decline in the background levels occurred during the mid-1970's. A model was developed to interpret the geographical distribution of the petroleum residues. The incidence and distribution of dissolved/dispersed petroleum residues in the waters of the Gulf of St. Lawrence and adjoining areas during the period 1970-79 could be interpreted in terms of general background levels pertaining to 'boxes' of water defined solely on the basis of oceanographic/geographic regimes. Since no relationship could be found between the concentration of these substances and depth or any of the other commonly measured oceanographic parameters and because the apparent differences between the concentration levels in neighboring boxes often were not significant, the background levels in the Gulf region at the time of each cruise could be accounted for by a simple model with four or five compartments. The present level, about 0.4 microg/L, is similar to those of other unpolluted areas off the east coast of Canada and in the Arctic where it appears that the input from atmospheric deposition exceeds those from accidental spills, deliberate discharges, and other point sources. Although small spills occur occasionally, their effects are usually local and short-term and have little lasting impact on the regional levels. Inputs of petroleum residues from land-based sources around the Gulf are presently insignificant except at the extreme upper reaches of the St. Lawrence Estuary and the Saguenay Fjord; even there the effect is highly localized because of dilution, sedimentation, and other processes of removal associated with the mixing of fresh and saline waters, and therefore, these sources do not make a significant contribution to the background level in the Gulf region as a whole. (Collier-IVI)
W86-01588

STORMWATER RUNOFF FROM HIGHWAYS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
E. J. Hoffman, J. S. Latimer, C. D. Hunt, G. L. Mills, and J. G. Quinn.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 349-364, August, 1985. 3 Fig, 8 Tab, 29 Ref. NOAA grant NA80RAD00047 and EPA grant 68-04-1002.

Descriptors: *Runoff, *Storm runoff, *Highway effects, *Pawtuxet River, *Rhode Island, Highways, Water pollution sources, Hydrocarbons, Trace metals, Metals, Urban runoff, Water quality management.

During four rain events, stormwater runoff samples from Interstate Highway 95 in Rhode Island were collected and analyzed for petroleum hydrocarbons, 14 polycyclic aromatic hydrocarbons (PAHs) and a variety of trace metals. The concentrations were variable throughout the storm events and some of the components responded similarly and others differently depending on the source and form of the component in the runoff. Loading factors as a function of area and traffic volume were developed from the concentration and flow data. Application of the highway runoff loading factors to the Pawtuxet River adjacent to this interstate highway suggests that highway runoff could be the source of over 50% of the annual pollutant loads of solids, PAHs, Pb, and Zn entering this river. It is recommended that highways as a source of non-point pollution to receiving waterbodies should be included as a part of any river and estuarine water quality management planning exercise. (Author's abstract)
W86-01605

IMPACT OF ALKALINE PARTICULATES ON PH OF RAIN WATER IN INDIA,
Indian Inst. of Tropical Meteorology, Poona.
L. T. Khemani, G. A. Momin, M. S. Naik, P. S. Prakasa Rao, and R. Kumar.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 365-376, August, 1985. 3 Fig, 9 Tab, 47 Ref.

Descriptors: *Precipitation chemistry, *Particulate matter, *Hydrogen ion concentration, *Alkalies, *India, Water pollution sources, Chemical composition, Acid rain, Calcium, Soil.

Rain water samples were collected over a period of a decade from 1974 in Pune, India, a city which is relatively free from industrial pollution. They were also collected at 4 places during 1974 in the region of Bombay which is highly industrialized. The samples were analyzed for major chemical components and pH. The ionic balance was computed. Samples were collected at Delhi during 1965 and 1966 and were analyzed for pH. The values were compared with those reported for 1978. The total suspended particles (TSP) were measured at Delhi during 1980 and analyzed for water soluble components. The rain water at all the places except near the industrial source was not acidic and was characterized by the presence of excess cations, particularly Ca. The acid rain near the industrial source was associated with excess anions, especially sulfate. The difference between the cations and anions was inversely proportional to the H(+) ion concentration. The pH of rain water at Delhi which was in the alkaline range during 1965 and 1966 remained alkaline after a period of 12 yr when the city developed industrially. The TSP in the region was rich with the basic components, mainly Ca, suggesting that the alkaline property of the soil dust is mainly responsible for neutralizing the acidic effects resulting from the anthropogenic gaseous pollutants. (Author's abstract)
W86-01606

CATALYTIC EFFECT OF VARIOUS METAL IONS ON THE METHYLATION OF MERCURY IN THE PRESENCE OF HUMIC SUBSTANCES,
Swedish Environmental Research Inst., Goeteborg.
Y.-H. Lee, H. Hultberg, and I. Andersson.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 391-400, August, 1985. 6 Fig, 3 Tab, 30 Ref.

Descriptors: *Methylation, *Mercury, *Path of pollutants, *Humic substances, *Metals, Heavy metals, Fulvic acid, Manganese, Aluminum, Iron, Copper, Catalysis, Hydrogen ion concentration.

Methylation of Hg(2+) (Hg(NO3)2) in the presence of fulvic acid (FA) and various metal ions has been studied. The concentrations of Hg(2+) and FA ranged from 5 to 200 mg/L and 171 to 285 mg/L dissolved organic carbon respectively. The pH range was 3 to 6.5. FA was isolated from an acid brown-water lake by XAD-8 polymeric adsorbent. Methylmercury production in the dark during 2 to 4 days incubation at 30 C increased with increasing concentrations of Hg(2+) ion and FA as well as with additions of metal ions (0.00005 mole/L). The observed catalytic activity of metal ions followed the order Fe(3+) (Fe(2+)) > Cu(2+) approximately = Mn(2+) > Al(3+). The production of methylmercury had a pH-optimum around 4 to 4.5 at the conditions tested. (Author's abstract)
W86-01607

POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER,
New York State Dept. of Environmental Conservation, Albany.
M. P. Brown, M. B. Werner, R. J. Sloan, and K. W. Simpson.
Environmental Science and Technology, Vol. 19, No. 8, p 656-661, August, 1985. 4 Fig, 41 Ref. EPA grant C-36-1167-01.

Descriptors: *Monitoring, *Polychlorinated biphenyls, *Hudson River, Fate of pollutants, Fish, Invertebrates, Rivers, Organic compounds, Sediments.

As part of a fish-monitoring program conducted in 1977, resident and migrant fish species have been collected at sites throughout the upper and lower portions of the Hudson River. PCBs have been analyzed in aquatic macroinvertebrates collected from the Hudson since 1977. Between 1978 and 1981 zooplankton samples were collected at 13 sites in the lower Hudson and analyzed for PCBs. Between 1977 and 1981 five monitoring stations were maintained in the upper and lower portions of the river. In 1976 and 1977 an extensive program of sediment sampling and mapping that involved collection of more than 100 grab and core samples was conducted in the upper Hudson River. The processes largely responsible for the decline in surficial sediment concentrations in the lower Hudson are dilution and burial by relatively cleaner sediments recently derived from soils in the watershed. Any relaxation of the 1976 restrictions placed on commercial and recreational fishing in the Hudson River will depend on the FDA limitation and on the continued decline of PCB concentrations in fish. The differential processing in the environment of PCB congeners, in addition to the continued decline in PCB concentrations in fish, will impose greater difficulty with the use of Aroclor-based analyses to support future environmental management decisions. (Baker-IVI)
W86-01616

CALCIUM CHEMISTRY AND DEPOSITION IN IONICALLY ENRICHED ONONDAGA LAKE, NEW YORK,
Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and C. T. Driscoll.
Environmental Science and Technology, Vol. 19, No. 8, p 716-720, August, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Calcium, *Fate of pollutants, *Onondaga Lake, *New York, Particulate matter, Primary productivity, Saturation, Calcium carbonate, Phosphorus, Epilimnion, Light attenuation.

The chemistry of aqueous calcium and the deposition of particulate calcium were studied in the epilimnion of calcium-polluted Onondaga Lake, NY, over a productive 7-month period. To evaluate calcium transformations, the water column was monitored for a number of pertinent water-quality parameters, and sediment traps were used to collect particulate material that settled from the epilimnion. Thermodynamic calculations indicate that the epilimnion of Onondaga Lake was oversaturated with respect to the solubility of CaCO3 (pK sub 80 = 8.48) for the entire period of summer stratification. The extent of oversaturation with respect to the solubility of CaCO3, and particulate calcium deposition, was significantly correlated with primary productivity. In-lake formation of CaCO3 not only influences calcium transport but also appears to enhance the downward transport of phosphorus and organic carbon, and contributes to light attenuation. (Author's abstract)
W86-01618

METHYLATION OF TIN AND LEAD IN THE ENVIRONMENT: OXIDATIVE METHYL TRANSFER AS A MODEL FOR ENVIRONMENTAL REACTIONS,
Leicester Polytechnic (England). School of Chemistry.
P. J. Craig, and S. Rapsomanikis.
Environmental Science and Technology, Vol. 19, No. 8, p 726-730, August, 1985. 4 Tab, 31 Ref.

Descriptors: *Lead compounds, *Tin compounds, *Methylation, *Fate of pollutants, Oxidation, Methyllead, Methyltin, Chemical reactions, Metals.

Methyltin and methyllead compounds (whose origin may not be gasoline anti-knock compounds) have been found in natural waters; these may be derived from environmental methylation. Reactions of tin and lead compounds with methyl carbonium ion donors were investigated because these metals are capable of undergoing oxidative addition reactions to the IV valence state. Tin(II) and lead(II) compounds were converted to methyltin and methyllead derivatives under conditions that model the natural environment, demonstrating the feasibility of environmental methylation for these elements and their compounds. Methylating agents that transfer methyl groups by oxidative addition and that occur environmentally were used (viz., CH3I, (CH3)3S(+)I(-), and (CH3)3N(+)CH2COO(-)). The reactions occurred at ambient temperatures in aqueous media. The results in general demonstrate that a mechanism does exist that can explain the observed detection of methyltin and (non-gasoline derived) methyllead compounds in the environment. Three natural methylating agents are capable of environmental methylation, and these are models for other naturally occurring methylating agents. (Moore-IVI)
W86-01619

CHEMICAL COMPOSITION OF FOGWATER COLLECTED ALONG THE CALIFORNIA COAST,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. J. Jacob, J. M. Waldman, J. W. Munger, and M. R. Hoffmann.
Environmental Science and Technology, Vol. 19, No. 8, p 730-736, 1985. 2 Fig, 6 Tab, 40 Ref. California Air Resources Board contract A2-048-32.

Descriptors: *Fog, *Chemical composition, *Acidity, *California, Coastal areas, Fogwater, Acid deposition, Chlorides, Nitrates, Air pollution, Water pollution sources, Urban areas.

Fogs are frequent seasonal occurrences along the California coast, and fogwater may have important local implications for acid deposition. Fogwater was sampled at eight coastal sites and one island site, using a rotating arm collector. Fogwater collected at both urban and nonurban coastal sites was found to be consistently acidic. Millimolar concentrations of NO3(-), and fogwater pH values below 3, were observed at sites downwind of the Los Angeles basin. Fogwater pH dropped down to 1.69 at a site downwind of the Los Angeles basin during a high sulfate pollution episode. The marine, continental, and anthropogenic contributions to the fogwater composition were determined from a source apportionment matrix for primary California aerosol. Fogwater composition at remote sites showed evidence of substantial continental and anthropogenic contributions. Acid-neutralizing capacities in coastal air were found to be very low and insufficient to neutralize even small acid inputs. Chloride loss in fogwater relative to its sea salt contribution was observed at sites furthest from anthropogenic sources. (Moore-IVI)
W86-01620

IDENTIFICATION OF NEW, FLUORINATED BIPHENYLS IN THE NIAGARA RIVER-LAKE ONTARIO AREA,
Indiana Univ., Bloomington. Dept. of Chemistry.
R. Jaffe, and R. A. Hites.
Environmental Science and Technology, Vol. 19, No. 8. p 736-740, August, 1985. 5 Fig, 1 Tab, 33 Ref. EPA grant 808961.

Descriptors: *Water pollution sources, *Fluorinated biphenyls, *Niagara River, *Lake Ontario, *Niagara Falls, *New York, Halogenated hydrocarbons, Fish, Sediments, Hazardous wastes, Waste dumps.

Bloody Run is a small creek that drains the Hyde Park hazardous waste dump in Niagara Falls (New York). Bloody Run Creek flows into the Niagara River, which is the major water source for Lake Ontario. Lake Ontario sediment cores were taken from the major sedimentation basins; sediment grab samples were collected from Bloody Run Creek, and the creek system adjacent to the Love Canal. Fish were sampled for the Niagara River, Lake Ontario, and the Little Niagara River. Sediment and fish samples were analyzed by capillary gas chromatographic mass spectrometry using negative ion methane chemical ionization. A series of bis(trifluoromethyl)-substituted polychlorinated biphenyls was discovered. These compounds were present in fish as well as in sediments, and their major source seems to be the Hyde Park dump in the city of Niagara Falls, NY. The concentrations of all compounds are 4-6 orders of magnitude higher in the Bloody Run Creek sediment than in Lake Ontario. (Moore-IVI)
W86-01621

COMBINED EFFECT OF GEOLOGY, PHOSPHATE SOURCES AND RUNOFF ON PHOSPHATE EXPORT FROM DRAINAGE BASIN,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
D. C. Grobler, and M. J. Silberbauer.
Water Research, Vol. 19, No. 8, p 975-981, 1985. 2 Fig, 2 Tab, 27 Ref.

Descriptors: *Phosphates, *Geological formations, *Runoff, *South Africa, Catchment areas, Water pollution sources, Non-point pollution sources, Bioavailability, Particulate matter.

A large degree of uncertainty is usually associated with phosphate loads estimated by means of export coefficients. Methods of reducing this uncertainty were investigated. Soluble and total phosphate export coefficients were calculated for 7 South African catchments over periods covering 3-5 years. Spatial variance in the export coefficients could largely be accounted for if catchments were grouped according to their geological characteristics; those in the upper Limpopo River drainage basin having igneous and those in the Vaal River drainage basin having sedimentary geological formations. A secondary, but nonetheless important factor contributing to the spatial variance of export coefficients was whether or not a particular catchment contained mainly point or mainly non-point sources. After catchments were grouped according to these two factors, 74%-99% of temporal variance of export coefficients could be explained by fitting linear regression equations to phosphate export vs runoff. The possible link between the bio-availability of particulate phosphorus and catchment geology is discussed. The significance of such a link, with regard to phosphate load estimates and making projections of future trophic status, is emphasized. (Author's abstract)
W86-01639

NITRATE BEHAVIOUR IN STREAMFLOW FROM A GRASSLAND CATCHMENT IN DEVON, U.K.,
Exeter Univ. (England). Dept. of Geography.
B. W. Webb, and D. E. Walling.
Water Research, Vol. 19, No. 8, p 1005-1016, 1985. 12 Fig, 3 Tab, 25 Ref.

Descriptors: *Nitrates, *Grasslands, *River Dart, *Devon, *England, Runoff, Seasonal variation, Storm runoff, Magnesium, Pollution load, Streams, Catchment area.

NO3-N levels and loadings in the River Dart, Devon, U.K. have been intensively monitored during the study period February 1975-January 1983, and NO3-N behavior in streamflow is compared with that of Mg which has predominantly contrasting origins and controls in runoff. A strongly developed annual regime characterizes daily mean NO3-N concentrations which peak at 4.5 mg/l in December and reach a minimum of 1.1 mg/l in early autumn, and this regime is reflected in a positive relationship between NO3-N concentration and discharge. Storm-period NO3-N behavior also exhibits a marked seasonal variation, and 'dilution' responses are typical of the winter period whereas a 'concentration' effect is more characteristic of summer months and is attributed to the influence of soil throughflow. Spring and autumn are associated with a transition in storm-period behavior, and the reaction of NO3-N concentrations during individual events or over a sequence of storms at any time of the year may also vary in response to a complex interplay of factors. NO3-N transport is more strongly biased towards storm events than is Mg, and more than 50% of the total NO3-N load was removed in only 10% of the study period. The mean annual NO3-N load for the study basin (24 kg/ha) is higher than that recorded in many grassland catchments of the U.K. but does not reflect an unusually high rate of fertilizer application. Unlike several other arable and grassland drainage basins studied in Britain, there is no evidence in the River Dart of a significant upward trend in NO3-N concentrations and loads since 1975. (Author's abstract)
W86-01642

ROLE OF MN(2+)-RICH HYDROUS MANGANESE OXIDE IN THE ACCUMULATION OF ARSENIC IN LAKE SEDIMENTS,
National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
T. Takamatsu, M. Kawashima, and M. Koyama.
Water Research, Vol. 19, No. 8, p 1029-1032, 1985. 4 Fig, 20 Ref.

Descriptors: *Arsenic, *Hydrous manganese oxide, *Lake sediments, Lake Biwa, Japan, Adsorption, Sediments, Manganese, Fate of pollutants.

The adsorption of As onto synthetic HMO and the association of Mn and As in the sediment cores from samples taken from Lake Biwa were examined. Arsenic has accumulated to high concentrations in the thin surface layers. The sedimentation rate suggests that the As-rich layers were deposited within the 4 years prior to sampling but no dramatic increase of As in flow to the lake was noted for that period. On the other hand, the coincident depth profiles of As and Mn concentrations in the cores and As concentrations up to 721 mg/kg in Mn concretions suggest that the surface accumulation of As may result from a dissolution-deposition cycle within the sedimentary column associated with that known to occur for Mn. In the absence of a divalent cation, no appreciable adsorption of arsenate onto HMO occurred between pH 6 and 8, a range often encountered in aquatic environments. There was a substantial increase in the amount of arsenate adsorbed by HMO in the presence of the divalent cations of Mn, Sr, Ba, and Ni. Hydrous Mn oxides, positively charged from the adsorption of Mn(2+) ions, could play a significant role in the accumulation of As on the surface of lake sediments. (Baker-IVI)
W86-01645

DIAGENETIC REMOBILIZATION OF MANGANESE, IRON, COPPER AND LEAD IN ANOXIC SEDIMENT OF A FRESHWATER POND,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
For primary bibliographic entry see Field 2H.
W86-01646

CHEMICAL CHARACTERIZATION OF STRATUS CLOUDWATER AND ITS ROLE AS A VECTOR FOR POLLUTANT DEPOSITION IN A LOS ANGELES PINE FOREST,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. M. Waldman, J. W. Munger, D. J. Jacob, and M. R. Hoffmann.
Tellus, Vol. 37B, No. 2, p 91-108, April, 1985. 8

Fig, 4 Tab, 55 Ref. California Air Resources Board contract A2-048-32.

Descriptors: *Cloudwater, *Acid deposition, *Forests, *Los Angeles, *Acid rain, *California, Hydrogen ion concentration, Pine trees, Nitrates, Sulfates, Rain, Fog precipitation, Calcium, Potassium.

Highly concentrated, acidic stratus cloudwater was monitored as it intercepted a pine forest (Henninger Flats) 25 km northeast of Los Angeles, California. Observed pH values ranged from 2.06 to 3.87 for over 100 samples collected in 1982 and 1983 with a median value below pH 3. The ratio of nitrate/sulfate in cloudwater samples was between 1.5 and 2; rainwater at the same site had a ratio of approximately 1. The solute deposition accompanying several light, spring rains (summing to about 1% of annual rainfall) was a disproportionate fraction of the annual total: H(+), NO3(-) and SO4(2-) were about 20% or more. Based on a reasonable estimate of fog precipitation, deposition of sulfate, nitrate and free acidity due to intercepting stratus clouds may be of comparable magnitude as that due to the incident rainfall at Henninger Flats. Cloudwater that had deposited on local pine needles was collected. It was in general more concentrated than ambient cloudwater but with comparable acidity. Enrichment of K(+) and Ca(2+) in those samples and in through fall is believed to be due to leaching from foliar surfaces. Injury to sensitive plant tissue has been noted in the literature when prolonged exposure to this severe kind of micro-environment has been imposed. (Author's abstract)
W86-01652

MODEL FOR NITRATE LEACHING IN UNDISTURBED STRUCTURED CLAY SOIL DURING UNSTEADY FLOW,
Oxford Univ. (England). Soil Science Lab.
R. E. White.
Journal of Hydrology, Vol. 79, No. 1/2, p 37-51, July, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Nitrates, *Leaching, *Unsteady flow, *Clay, Mixing, Model studies, Unsaturated flow, Solute transport, Diffusion, Chlorides, Nitrification, Soil water, Mathematical equations.

A two-domain mixing model is described for predicting nitrate leaching during unsteady unsaturated flow through soil. The model assumes that water infiltrating the soil surface mixes incompletely with resident water to form a miscible transport volume, the size of which can vary with time. Changes in solute storage within the transport volume can occur by diffusion and biological transformations. Output from the transport volume is by drainage from a lower surface in the soil. The model's output was tested against the measured amounts of NO3-N leached from large undisturbed cores of structured clay soil during constant flux irrigation with 10 mM CaCl2. The average concentration of NO3(-) and Cl(-) in the soil solution was determined by extraction of small cores taken around the large cores prior to leaching. The rate of nitrification in the soil was also measured. The change in the transport volume with time was calculated from equations for the mass balance of water and Cl(-) in the transport volume. Knowing the transport volume, analogous equations in terms of NO3(-) were solved to predict the NO3(-) concentration in the effluent. Good agreement between predicted and observed NO3-N leached was obtained for cores showing divergent trends in NO3(-) leaching. A large difference between cores in the fraction of soil NO3-N leached (0.34 compared to 0.13) was attributed to the difference in the volume of high-nitrate soil water that mixed with infiltrating water to form the transport volume, and to differences in the distribution of NO3(-) between ped faces and ped interiors. The merit of incorporating the concept of a variable transport volume into a transfer function model for predicting NO3(-) leaching is briefly discussed. (Author's abstract)
W86-01655

LEACHING FRACTION BEYOND DEPTH X, CAUSED BY PERCOLATION OF A SOIL PROFILE WITH AN INITIAL SALT ACCMULATION AT ITS SURFACE,
Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2G.
W86-01662

GEOCHEMICAL MASS BALANCE OF A VOLCANIC CRATER LAKE IN AUSTRALIA,
Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-01663

DISPERSAL PATHWAYS FOR PARTICLE-ASSOCIATED POLLUTANTS,
Exxon Production Research Co., Houston, TX.
R. A. Young, D. J. P. Swift, T. L. Clarke, G. R. Harvey, and P. R. Betzer.
Science, Vol. 229, No. 4712, p 431-435, August, 1985. 5 Fig, 27 Ref.

Descriptors: *Dispersion, *Path of pollutants, *Fate of pollutants, *New York Bight, *New York, *Particulates, Water pollution sources, Ocean dumping, Coastal waters, Model studies, Estuarine environment, Sediment transport, Particulate transport.

A prototype study of the effects of dumping of anthropogenic wastes into the ocean has been the New York Bight Program of the National Oceanic and Atmospheric Administration. Particle-associated pollutants (totaling 10 to the 7th power metric tons per year) are introduced into the New York Bight by ocean dumping, estuarine discharge, sewage outfalls, eolian transport, and shipping waste and spillage. Because pollutants are associated with fine sediment particles, their fate in the New York Bight is intimately related to sediment transport processes. Sediment transport in the Bight is not a simple function of fluid transport. A combined flow boundary layer model was developed to improve near-bottom sediment transport predictions, and semiempirical relations were derived to predict resuspension of the small amounts of pollutant-bearing mud dispersed in the sand-dominated substrate. Oceanic and estuarine circulation processes dilute and transport the particles by a natural dispersal system that also tends to be highly distributive; particle-associated pollutants apparently seek the same sinks in the Hudson River shelf valley and intracoastal wetlands, regardless of their point of introduction. These sinks are inferred to be largely within the intracoastal zone of marshes, estuaries, and lagoons, and it is these areas that may determine the pollutant-related assimilative capacity of the New York Bight Apex as a whole. (Collier-IVI)
W86-01677

GROUND WATER QUALITY ANOMALIES ENCOUNTERED DURING WELL CONSTRUCTION, SAMPLING AND ANALYSIS IN THE ENVIRONS OF A HAZARDOUS WASTE MANAGEMENT FACILITY,
Woodward-Clyde Consultants, Walnut Creek, CA. Environmental and Engineering Services.
For primary bibliographic entry see Field 5A.
W86-01700

BIOGEOCHEMISTRY OF LEAD IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,
Oak Ridge National Lab., TN.
R. S. Turner, A. H. Johnson, and D. Wang.
Journal of Environmental Quality, Vol. 14, No. 3, p 305-314, 1985. 8 Fig, 7 Tab, 38 Ref. U.S. Dep. of Energy contract DE-ACO5-840R21400.

Descriptors: *Geochemistry, *Biochemistry, *Lead, *McDonalds Branch watershed, *Pine Barrens, *New Jersey, *Heavy metals, Metals, Fate of pollutants, Atmospheric deposition, Water pollution sources, Air pollution, Precipitation, Plant tissues, Forest soils, Soil horizons.

Lead concentrations, fluxes, and storage were measured in the vegetation, forest floor, and acid, sandy mineral soil (Quartzip-samments) of a forested watershed watershed in the New Jersey Pine Barrens. Atmospherically deposited Pb at the McDonalds Branch Watershed was 140 g/ha/yr (8 micro-g/L in bulk precipitation) in 1980 to 1982, a substantial reduction from 350 g/ha/yr (17 micro-g/L in bulk precipitation) in 1978 and 1979. Virtually all Pb falling on the uplands was retained - 75% by the organic forest floor and 25% by mineral soils, especially in B and C soil horizons. Total Pb content of the forest floor was 7.6 kg/ha, with an accumulation rate of 100 g/ha/yr (1980-1982), or 1.3% of the forest floor pool. Estimated mean residence time of Pb in the forest floor was 220 yr. About 35 g Pb/ha/yr moved out of the forest floor in solution through the E horizon and was correlated strongly with dissolved organic matter. Approximately 30 g Pb/ha/yr accumulated in the B and C soil horizons. Less than 1 g Pb/ha/yr percolated past a depth of 2 m. Lowland muck soils and vegetation accumulated 98% of incoming Pb, with only 3.2 g Pb/ha/yr exported in the stream. Lead concentrations in the stream were correlated positively with dissolved organic matter and water level in the swamps. Lead in biota was contained mainly in the bark, fine roots, and foliage. Concentrations were: Fine roots (18 mg/kg) > bark (15 mg/kg) > foliage (4 mg/kg) > wood (0.5 mg/kg). Although Pb concentrations in herbs, mosses, and lichens ranged from 10 to 60 mg/kg, these plants accounted for very little biomass. Total Pb content of biota was 355 g/ha, about 4% of the forest floor Pb content. (Author's abstract)
W86-01703

BIOGEOCHEMISTRY OF ALUMINUM IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,
Oak Ridge National Lab., TN.
R. S. Turner, A. H. Johnson, and D. Wang.
Journal of Environmental Quality, Vol. 14, No. 3, p 314-323, 1985. 7 Fig, 5 Tab, 42 Ref.

Descriptors: *Biochemistry, *Geochemistry, *Aluminum, *McDonalds Branch watershed, *Pine Barrens, *New Jersey, *Trace metals, *Fate of pollutants, Acid precipitation, Forest soils, Plant tissues, Soil horizons, Soil water, Hydrogen ion concentration, Metals, Water pollution effects.

Aluminum concentrations, fluxes, and storage were measured in the vegetation, forest floor, and acid, sandy mineral soil of a forested watershed in the New Jersey Pine Barrens. Volume-weighted mean Al concentrations in solution increased as water passed through the upland ecosystem, from 0.012 mg/L in bulk precipitation to 0.14 mg/L in throughfall to 0.45 mg/L in E horizon mineral soil, 0.60 mg/L in the B horizon, and 0.73 mg/L in the C horizon. Weighted mean Al concentration of the stream water was 0.15 mg/L. Solution Al concentrations in different compartments of the ecosystem were related to the magnitude of moisture flux, dissolved organic carbon concentration, and pH. Soil solution and stream water Al concentrations were high in the winter and spring and low in the summer and fall, inversely following solution pH. Soil solution and stream pH were independent of precipitation pH because of internal control of H(+) concentration by the soil and an apparent 0.5-yr time lag in flushing of atmospherically deposited acids through the soil. Aluminum was partitioned strongly into the lower mineral soil horizons, but large stores of potentially labile Al were found in the upper mineral horizons and forest floor. Standing vegetation represented a relatively small pool of Al but cycled substantial amounts of Al between mineral soil and the forest floor. (Author's abstract)
W86-01704

LEAD DISTRIBUTION AND FLUXES IN A HIGH-ELEVATION FOREST IN NORTHERN VERMONT,
Pennsylvania Univ., Philadelphia.
A. J. Friedland, and A. H. Johnson.
Journal of Environmental Quality, Vol. 14, No. 3, p 332-336, 1985. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Lead, *Vermont, *Forests, *Forest soils, *Heavy metals, *Fate of pollutants, Conifer-

ous forests, Atmospheric deposition, Water pollution sources, Metals, Leaching, Residence time, Trees, Plant tissues, Streams.

High-elevation forests receive large amounts of atmospheric lead (Pb) and accumulate it in the forest floor. In order to determine Pb partitioning in a montane, coniferous forest, forest floor and mineral soil (Haplorthods and Fragiorthods) and vegetation parts (leaves, twigs, bark, wood) were analyzed for their Pb content. Soil and stream water were sampled to estimate Pb flux. Mean Pb concentration in trees, in mg/kg, was root bark (33.0), twigs (28.3), bark (23.0) > root wood (10.4) > foliage (3), wood (3). Total Pb in above-ground biomass (trees + shrubs + herbs) was 0.89 kg/ha. Lead in the organic horizon (forest floor) was 20 kg/ha while Pb in the mineral horizon (E + B) was 63 kg/ha. Monitoring of soil water for one year yielded volume-weighted mean Pb concentrations of 3.7, 1.8, 1.1 and 1.0 micro-g/L at 3-, 12-, 25-, and 40-cm depth, respectively. Stream Pb concentration averaged 0.6 micro-g/L. Annual Pb input is estimated to be > 700 g/ha/yr. Estimated output from the forest in stream water was < 12 g/ha/yr. Annual accumulation in the forest floor is approximately 3% of the current forest floor Pb amount. At current accumulation rates, forest floor Pb amount will double in 30 to 40 yr. At current leaching rates, mean residence time of Pb in the forest floor is approximately 500 yr. The ratio of Pb input to output for the forest is 60:1. (Author's abstract)
W86-01706

REDUCTIVE DECHLORINATION OF THE PESTICIDES 2,4-D, 2,4,5-T, AND PENTACHLOROPHENOL IN ANAEROBIC SLUDGES,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5D.
W86-01707

DISSIPATION OF CARBARYL AND THE 1-NAPHTHOL METABOLITE IN FLOODED RICE FIELDS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
L. E. Deuel, K. W. Brown, J. D. Price, and F. T. Turner.
Journal of Environmental Quality, Vol. 14, No. 3, p 349-354, 1985. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Carbaryl, *Napthol, *Rice fields, *Fate of pollutants, Irrigation management, Pesticides, Insecticides, Rainfall, Crop production.

Field and laboratory experiments were conducted under flooded rice (Oryza sativa L.) culture to evaluate persistence of carbaryl (1-napthyl-N-methyl carbamate) and the 1-naphthol metabolite. Treatments consisted of two rates of carbaryl (1.12 and 5.60 kg/ha) super-imposed on two irrigation management schemes (ie, intermittent and continuous flow) to determine their potential for environmental contamination. Results showed that foliarly applied carbaryl was washed from the rice canopy into plot water and subsequently degraded via chemical and biological mechanisms. Time of sample collection and application rate had a highly significant influence on the residual levels of carbaryl in the flood water for each of the 3 yr tested. The effect of irrigation management was statistically significant in two of the three seasons studied, with greater levels of carbaryl residues observed for the intermittent irrigation scheme. Carbaryl residues in plot water were greatest in those years when a rainfall event occurred within 24 h following the foliar spray application. A significant first order interaction between time and application rate was observed in 1973 and 1975, when measurable rainfall was recorded prior to the 24-h sampling period. The 1-Naphthol recovered in the plot water was proportional to the contamination level of the carbaryl spray formulation did not reflect the quantities of dissipated carbaryl. Field results and laboratory experiments suggested that 1-naphthol was degraded more rapidly under flooded soil conditions than carbaryl. (Author's abstract)
W86-01708

NUTRIENT RUNOFF LOSSES AS PREDICTED BY ANNUAL AND MONTHLY SOIL SAMPLING,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, S. J. Smith, W. A. Berg, and J. R. Williams.
Journal of Environmental Quality, Vol. 14, No. 3, p 354-360, 1985. 4 Fig, 6 Tab, 24 Ref.

Descriptors: *Nutrients, *Runoff, *Soil sampling, *Prediction, Phosphorus, Nitrogen, Grasslands, Nutrient transport.

The transport of soluble and particulate P and N in runoff from several cropped and grassed watersheds in Oklahoma and Texas was related to the nutrient content of surface soil (0-50 mm) sampled monthly and annually (March) over a 2-yr period in an effort to improve the prediction of nutrient transport. For both monthly and annual soil samplings, the prediction of soluble P was good for events > 0.75 mm runoff (r values ranged from 0.57 to 0.92), but smaller events were poorly predicted. The nitrite content of runoff was not closely related to surface soil content (r values ranged from 0.17 to 0.58), precluding its accurate prediction in runoff. Prediction of both particulate P and total N concentrations of individual runoff events was improved using separate equations for grassed and cropped watersheds compared to a general equation. Even so, predicted mean annual flow-weighted concentrations and amounts of soluble P, particulate P, and total N using either monthly or annual soil nutrient data were significantly related to measured values at the 0.01 level and above (r values ranged from 0.57 to 0.97). Results indicate that seasonal variation in soil nutrient content had less effect on the predictive equations than rainfall and management characteristics. Consequently, these characteristics must be accounted for before the transport equations can be reliably used on an individual runoff event basis. (Author's abstract)
W86-01709

DESCRIPTION AND APPLICATION OF AN ANIMAL WASTE PHOSPHORUS LOADING MODEL,
Wisconsin Univ.-Madison.
I. C. Moore, and F. W. Madison.
Journal of Environmental Quality, Vol. 14, No. 3, p 364-369, 1985. 6 Tab, 30 Ref.

Descriptors: *Animal wastes, *Phosphorus loading, *Nutrients, Manure, Model studies, Fate of pollutants, Water pollution sources.

An animal waste loading model was developed to estimate total phosphorus (P) loadings from winter-spread manure, barnyards and feedlots, and aboveground manure storage facilities. Literature studies were used to establish the percentage of manure P which could potentially be carried in runoff from a specific manure source. Likewise, a critical distance over which manure polluted runoff must travel as overland flow in order for P to be reduced to background levels was established. The model was tested on a 328-ha watershed in Shawano County, WI, which is devoted to dairy agriculture and where surface water was monitored and intensive land use inventories were completed. For the years 1974 to 1976, the model predicted total P loadings from animal wastes of 96.0 kg/yr, of which 24.6 kg/yr or 26% was attributed to winter spreading, and the balance of 71.4 kg/yr or 74% to runoff from barnyards and above-ground storage facilities. The animal waste model was linked to a model estimating cropland losses of total P to develop a prediction of total P losses from the watershed. Comparison between predicted and monitored values suggested that the animal waste model was a useful tool for estimating total P losses from various waste handling practices on a long-term basis. As such, it will serve as a valuable planning tool for nonpoint source abatement programs. (Author's abstract)
W86-01710

SORPTION AND TRANSPORT OF HYDROPHOBIC ORGANIC CHEMICALS IN AQUEOUS AND MIXED SOLVENT SYSTEMS: MODEL DEVELOPMENT AND PRELIMINARY EVALUATION,
Florida Univ., Gainesville. Dept. of Physics.
P. S. C. Rao, A. G. Hornsby, D. P. Kilcrease, and P. Nkedi-Kizza.
Journal of Environmental Quality, Vol. 14, No. 3, p 376-383, 1985. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Pollutant transport, *Sorption, *Organic chemicals, *Model studies, *Fate of pollutants, Solubility, Waste disposal, Solvophobic theory.

A theoretical approach, based upon the assumption of predominance of solvophobic interactions, was formulated to quantitatively describe the sorption and transport of hydrophobic organic chemicals (HOC) from aqueous and aqueous-organic-solvent mixtures. In the theoretical approach, solvent-sorbate interactions (solubility) are specifically considered in order to predict sorbate-sorbent interactions (sorption). For HOC sorption from a single solvent, the HOC sorption coefficient was shown to increase loglinearly with the hydrocarbonaceous surface area (HSA) of the sorbate. For HOC sorption from aqueous-organic binary solvent mixtures, the sorption coefficient is predicted to decrease exponentially as the fraction of organic cosolvent increases. This is a direct consequence of increased HOC solubility in the binary solvent. Because sorption and mobility of HOC are inversely related, a decrease in sorption coefficient leads to an enhanced HOC mobility as the fraction of organic cosolvent is increased. A preliminary verification of the theory was performed by an analysis of published data for (i) HOC sorption by soils and sediments from water, (ii) HOC retention by reversed-phase chromatographic sorbents during isocratic elution with methanol-water binary solvent mixture, and (iii) HOC mobility on soil-TLC plates eluted with ethanol-water mixtures. (Author's abstract)
W86-01711

USING CREAMS AND ECONOMIC MODELING TO EVALUATE CONSERVATION PRACTICES: AN APPLICATION,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
B. M. Crowder, H. B. Pionke, D. J. Epp, and C. E. Young.
Journal of Environmental Quality, Vol. 14, No. 3, p 428-434, 1985. 1 Fig, 2 Tab, 21 Ref. Pennsylvania Agricultural Exp. Stn. project 2587.

Descriptors: *Soil conservation, *Model studies, *Economic aspects, Nutrient loss, Conservation, Erosion, Agricultural runoff, Nonpoint pollution sources, Conservation tillage.

Economic modeling of the impacts of soil loss from agricultural activities traditionally has been based on the Universal Soil Loss Equation (USLE). Most studies have not considered the effects of agricultural production on N, P, and pesticides in runoff. This study, involving a representative Pennsylvania dairy farm, uses the CREAMS model (Chemicals, Runoff, and Erosion from Agricultural Management Systems) to estimate surface runoff losses of soil, plant nutrients, and pesticides. The CREAMS is a continuous simulation model that allows the user to compare the effectiveness of management practices for reducing these losses in a consistent and comprehensive manner. The usefulness of the CREAMS simulation model is demonstrated for analysis of agricultural cropping activities and their impacts on losses of chemicals and soil in runoff. Linear programming was used to simulate the impacts of farm-level water pollution restrictions on farm income. Nonpoint source pollution can be reduced without necessarily reducing farm income. Farm income levels could be maintained by adopting conservation tillage practices or by changing crop rotation. Conservation tillage was found to be the most effective method for maintaining income when water pollution restrictions were imposed. Two years of corn (Zea mays) followed by 3 yr of alfalfa (Medicago sativa) was a profitable and effective rotation for controlling runoff losses. Continuous corn, at the other extreme, caused substan-

tial losses of income when restrictions were imposed. (Author's abstract)
W86-01715

REDISTRIBUTION OF BROMIDE BY RAINFALL INFILTRATION INTO A CECIL SANDY LOAM LANDSCAPE,
Agricultural Research Service, Watkinsville, GA.
R. R. Bruce, R. A. Leonard, A. W. Thomas, and W. A. Jackson.
Journal of Environmental Quality, Vol. 14, No. 3, p 439-445, 1985. 13 Fig, 3 Tab, 12 Ref.

Descriptors: *Bromide, *Rainfall, *Infiltration, *Soil types, Solute transport, Leaching, Erosion, Topography, Permeability coefficient.

The redistribution of bromide applied to the soil surface at selected position in a sample Cecil sandy loam (clayey, kaolinitic, thermic Typic Hapludults) landscape was measured in relation to rainfall and pedon characteristics. Three bromide application sites were located in drainageway positions and three on slope positions exhibiting different degrees of erosion. Observations of nearly 4 yr measured 4.7 m of rainfall to show that rainfall was more effective in transporting Br through drainageway pedons than those on the slopes. After 1000 mm of rainfall, half of the applied Br was above 0.6 m on the slope sites and above 1.0 m on the drainageway sites. This difference seems to relate closely to the higher hydraulic conductivity in the Bt horizon above the 1.2 m in the drainageway pedons than in the slope pedons. Also, the maximum clay zones in the Bt horizons of the drainageway sites were significantly lower than those on the slope sites and occurred about 0.5 m deeper. At the completion of this study, an elevated Br level was measured in a drainageway site between 1.5 and 2.4 m with no evidence of Br below 3.8 m. These data provide a basis for assigning solute transport characteristics to the identified variability in this and similar landscapes. (Author's abstract)
W86-01716

SIMULTANEOUS IN-STREAM NITROGEN AND D.O. BALANCING,
Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
For primary bibliographic entry see Field 2H.
W86-01722

NITROGEN ACCOUNTABILITY FOR FERTILE STREAMS,
Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
For primary bibliographic entry see Field 2H.
W86-01723

OUTFALL DILUTION: THE ROLE OF A FAR-FIELD MODEL,
Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
D. A. Chin.
Journal of Environmental Engineering, Vol. 111, No. 4, p 473-486, August, 1985. 10 Fig, 6 Ref.

Descriptors: *Outfall, *Far-field models, *Model studies, *Dilution, Wastewater outfall, Near-field mixing, Far-field mixing, Fate of pollutants, Path of pollutants, Coastal waters.

Effluent dilutions predicted by near-field models do not realistically reflect near-field conditions in tidally influenced coastal waters since they neglect the advection of the pollutant cloud over the source. A theoretical solution has been developed for the case in which a conservative pollutant is released from a line source into a uniform unsteady flowing ambient where diffusion is only significant in the cross-stream direction. Considering the case of a sinusoidal variation of velocity along the streamwise principal axis, it has been shown that the expected concentration at a source located in a typical flow field may increase by as much as 15% per cycle over that predicted by the near-field model. A hypothetical outfall was analyzed using real data and a dispersion model which accounts for the near-, as well as far-field mixing. The near-field model was found to underestimate the average dilution at the source by about 21%. Extreme values were also underestimated. The results of this study indicate that a complete dispersion model should be used in predicting dilutions in outfall mixing zones of coastal regions. (Author's abstract)
W86-01727

SIMULATION OF TWO-FLUID RESPONSE IN VICINITY OF RECOVERY WELLS,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-01733

OCCURRENCE AND DISSIPATION OF HIGH LEAD LEVEL EPISODES IN THE LOWER MISSISSIPPI RIVER,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
I. A. Kahwa, and E. J. Newchurch.
Journal of Environmental Sciences and Health, Vol. A20, No. 4, p 395-417, 1985. 8 Fig, 1 Tab, 11 Ref.

Descriptors: *Lead, *Heavy metals, *Mississippi River, Water pollution, Path of pollutants, Metals, Fate of pollutants.

Previous investigations involving lead in the lower Mississipi River generally reported low levels, prompting the conclusion that human activity has not resulted in undesirable lead levels in the river water. Our studies reveal that of 435 samples collected between 1978 and mid-1983 from stations at river miles 266, 202, 147, 120, 75 and 49, about 9% had total lead levels exceeding the EPA allowable for drinking water. These values include one of 10,000 micro-g/l and 5 larger than 500 micro-g/l (10 times the EPA allowable). On the basis of the observed variability of lead levels in time and distance, it is concluded that (a) the high lead levels are associated with the Lutcher-Luling-Belle Chasse river stretch (i.e., river miles 147-75); (b) the problem is a result of human activity; and (c) there are mechanisms for the relatively rapid removal of lead and/or dilution of high-lead episodes as the river water flows down stream. (Author's abstract)
W86-01735

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA; 1. THE NONREACTIVE CASE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W86-01775

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA 2. THE REACTIVE CASE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W86-01776

STREAMFLOW NITROGEN LOSS FOLLOWING FOREST FERTILIZATION IN A SOUTHERN VANCOUVER ISLAND WATERSHED,
Pacific Forest Research Centre, Victoria (British Columbia).
E. D. Hetherington.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 34-41, February, 1985. 5 Fig, 6 Tab, 33 Ref.

Descriptors: *Fertilization, *Nitrogen, *Forest watersheds, *Vancouver Island, *British Columbia, Fir trees, Water quality, Urea, Ammonia, Nitrates, Fate of pollutants, Nitrification, Streams.

Water quality was monitored in the Lens Creek watershed on southern Vancouver Island (British Columbia) to determine nitrogen loss following fall application of 224 kg N/ha urea fertilizer on a second-growth Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) forest. Peak nitrogen concentrations measured in two small tributary streams were 14 mg/L as urea, 1.9 mg/L as ammonia, and 9.3 mg/L as nitrate. For the first 14 months, estimated nitrogen outputs in excess of background amounts were 5.9 and 14.5% of the total applied nitrogen for the two subsidiary watersheds with 46 and 80% of their drainage areas fertilized, respectively. These losses were considerably higher than amounts of less than 1% previously reported for western North America. Increased levels of urea N and ammonia N were short-lived, while nitrate N remained above background levels for the study duration. Reasons for the high nitrogen loss include nitrification of the urea during 7 weeks of mild, dry weather following fertilization, presence of alder and swampy areas adjacent to the streams, high soil permeability, steep slopes, and abundant, above average early winter rainfall. The watersheds had been previously fertilized, but any influence of this first fertilization on nitrogen loss during the present study in unknown. Lens Creek water quality was not adversely affected by the fertilization in terms of drinking water standards or toxicity to fish. (Author's abstract)
W86-01784

DISTRIBUTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE SURFICIAL SEDIMENTS OF PENOBSCOT BAY (MAINE, USA) IN RELATION TO POSSIBLE SOURCES AND TO OTHER SITES WORLDWIDE,
Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
A. C. Johnson, P. F. Larsen, D. F. Gadbois, and A. W. Humason.
Marine Environmental Research, Vol. 15, p 1-16, 1985. 2 Fig, 2 Tab, 31 Ref. NOAA-NMFS contract NA-80-FA-C-0008.

Descriptors: *Polycyclic aromatic hydrocarbons, *Sediments, *Penobscot Bay, *Maine, Hydrocarbons, Aromatic compounds, Air pollution, Particulate matter, Combustion products, Water pollution sources.

Sediments from the Penobscot Bay region of the Gulf of Maine were analyzed by high pressure liquid chromatography and gas chromatography-mass spectrometry for polycyclic aromatic hydrocarbons (PAHs). Total PAH concentrations ranged from 286 to 8794 ppb (dry weight) and formed a distinct gradient decreasing seaward from the head. Gradients of decreasing concentration were also measured in the various harbors in the bay. PAH composition was uniform throughout Penobscot Bay. Atmospherically transported particulate combustion products are hypothesized as a major source of PAH contamination. Sedimentary PAH concentrations from around the world which have been reported in the literature are compiled in a table. PAH levels in Penobscot Bay sediments fall within the range found in industrialized regions throughout the world and are significantly higher than would be expected for an area previously considered to be uncontaminated. (Author's abstract)
W86-01795

TRACE METALS AND HYDROCARBONS IN SEDIMENTS FROM THE SOUTHAMPTON WATER REGION, WITH PARTICULAR REFERENCE TO THE INFLUENCE OF OIL REFINERY EFFLUENT,
Southampton Univ. (England). Dept. of Oceanography.
H. Armannsson, J. D. Burton, G. B. Jones, and A. H. Knap.
Marine Environmental Research, Vol. 15, p 31-44, 1985. 2 Fig, 2 Tab, 35 Ref.

Descriptors: *Trace metals, *Hydrocarbons, *Sediments, *Southampton Water, *England, Estuarine environment, Oil refineries, Effluents, Cobalt, Nickel, Copper, Zinc, Silver, Cadmium, Mercury, Water pollution sources.

The concentrations of a number of trace metals (Co, Ni, Cu, Zn, Ag, Cd and Hg) have been determined in sediments from cores collected in the Southampton Water region (England). Meas-

urements of total hydrocarbons were also made on several of the cores. Markedly elevated concentrations of copper, up to 362 micro-g/g dry wt, were found in sediments which were collected close to the discharge points of oil refinery outfalls and which also showed concentrations of total hydrocarbons considerably greater than the background levels for the estuary. The results of selective chemical extractions showed that much of the copper was present in the non-lattice fraction of the sediment. Although the concentrations of Co, Ni, Zn, and Cd were significantly correlated with those of copper in the core showing the highest concentrations of this element, these metals were not enhanced in comparison with the levels found in several other parts of the estuary. Variations in concentrations of metals in sediments throughout the estuary were not correlated with differences in organic carbon content. (Author's abstract)
W86-01797

SULFIDE CONTROL OF CADMIUM AND COPPER CONCENTRATIONS IN ANAEROBIC ESTUARINE SEDIMENTS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
R. J. Davies-Colley, P. O. Nelson, and K. J. Williamson.
Marine Chemistry, Vol. 16, No. 2, p 173-186, 1985. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Sulfides, *Cadmium, *Copper, *Anaerobic conditions, *Sediments, *Estuarine environment, Geochemistry, Chemical reactions, Trace metals, Heavy metals, Iron sulfide, Metals, Pore water, Fate of pollutants.

Equilibrium concentrations of the toxic trace metals copper and cadmium were calculated for the physico-chemical conditions characterizing pore waters of anaerobic estuarine sediments using available thermodynamic data and assuming simple sulfide minerals control solubilities. Polysulfide complexes are responsible for the solubility of copper in the cuprous (Cu(I)) oxidation state. Predicated copper concentrations, assuming covellite (CuS) is the controlling solid phase, are in reasonable agreement with copper analyses in a wide range of sulfidic waters and sediment pore waters. In the absence of thermodynamic data, no account could be taken of possible polysulfide complexes of cadmium. However, bisulfide complexes appear to account satisfactorily for observed solubilities assuming the existence of greenockite (CdS) as the controlling solid phase. Anaerobic estuarine sediments may act as a sink for copper and cadmium in the common situation in which free sulfide concentrations are controlled by the coexistence of iron sulfide and iron oxide minerals. However, where free sulfides reach high concentrations of 0.001 M or more the concomitant increase in concentration of bisulfide and polysulfide complexes may result in the sediments acting as a source of copper and cadmium. (Author's abstract)
W86-01800

SELF-SIMILAR CHARACTER OF THE PROPAGATION OF A DENSITY FRONT IN A SHALLOW WATER BODY,
Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
A. G. Kostyanoi, and G. I. Shapiro.
Water Resources, Vol. 11, No. 4, p 335-342, July-August, 1984. 6 Fig, 14 Ref. Translated from Vodnye Resursy, No. 4, p 82-89, July-August 1984.

Descriptors: *Water intrusions, *Density fronts, *Plumes, *Heated water, *Power plants, Thermal pollution, Laminar flow, Viscosity, Shallow water.

Currents caused by differences in the density of contracting water masses occur during discharge of warm waters by electric power stations and industrial enterprises, penetration of sea water as a salt wedge into river estuaries and for other reasons. All cited works on slow intrusions, both experimental and theoretical, pertain to the case of a deep water body, when the viscous boundary layer does not have time to spread to the bottom during the characteristics time of evolution of the front, so that all changes in the velocity of the fluid are concentrated near the intrusion layer. More complex is the case of slow fluid flows in a shallow water body, when the boundary layers spread relatively rapidly, so that the vertical velocity gradients in any layer and bottom friction can no longer be neglected. Such a case was theoretically examined on a model of a two-layer stratified fluid. If the frontal surface intersects the free surface of the fluid or the bottom, forming a front, then the equations describing the evolution of the frontal surface are essentially nonlinear, since in the zone of the front the thickness of the corresponding fluid layer vanishes. Therefore the deviations of the frontal surface from an equilibrium position are comparable with the thickness of one of the layers and they cannot be considered small. Consequently linearization of the equations near the front is inadmissible. Nevertheless, in certain cases it is possible to obtain a number of results analytically and to compare theory and experiment. Particular concern in this work centers on the slow plane-parallel flows of a viscous incompressible two-layer density-stratified fluid in a shallow water body. (Baker-IVI)
W86-01807

EFFECT OF THE CONTENT OF ORGANIC MATTER IN SOIL ON LEACHING OF CHEMICAL FERTILIZERS INTO THE ZONE OF AERATION AND GROUNDWATERS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. V. Lola, N. P. Akhmet'eva, and Yu. A. Medovar.
Water Resources, Vol. 11, No. 3, p 223-227, May-June, 1984. 2 Fig, 4 Tab, 4 Ref. Translated from Vodnye Resursy, No. 3, p 68-72, May-June, 1984.

Descriptors: *Organic matter, *Soil, *Leaching, *Fertilizers, Groundwater pollution, Aeration zone, Nitrogen, Potassium, Phosphorus, Sediments.

To study the possibility of the penetration of fertilizer components into groundwaters, experiments were conducted on the application of fertilizers at rates of 100 kg/ha of active ingredient of each fertilizer. In field experiments, increasing rates of organic sediments, from 50 to 2000-3000 tons/ha, were applied to the soil. The yield of barley grain increased, and simultaneously the mobility of biogenic elements in the soil decreased. The soil application of organic sediments in amounts greater than 500 tons/ha is economically unprofitable, and technically difficult to accomplish. Application rates of organic sediments less than 500 tons/ha do not produce sufficiently high yields. The effect of organic sediments applied to the soil on its adsorbing capacity for chemical fertilizers was studied. An increase in the content of organic matter in soil led to retention of ammonium and nitrate nitrogen in the zone of aeration. Without the application of bottom sediments, the concentration of nitrate nitrogen was at the usual level found in unfertilized soil. Generally, an increase in the content of nitrogen, phosphorus, and potassium was observed in the plow layer with increased application rates of organic matter. The exception was water soluble potassium, the content of which was minimum in the variant with the maximum application rate of organic matter. A decrease in leaching of biogenic elements was noted with an increase of application rate of organic sediments, except nitrate nitrogen. (Baker-IVI)
W86-01822

PHOTOCHEMICAL BEHAVIOR OF CHLORSULFURON IN WATER AND IN ADSORBED PHASE,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
M. Herrmann, D. Kotzias, and F. Korte.
Chemosphere, Vol. 14, No. 1, p 3-8, 1985. 3 Fig, 15 Ref.

Descriptors: *Photochemistry, *Chlorsulfuron, *Fate of pollutants, Herbicides, Natural waters, Solar radiation, Ultraviolet radiation, Photosensitivity, Fate of pollutants.

The photochemistry of the herbicide chlorsulfuron (2-chloro-N-((4-methoxy-6-methyl-1,3,5-triazinyl-2-amino)carbonyl)benzene sulfonamide) was investigated in methanol, distilled water, natural creek-water, on silica gel and on montmorillonite surfaces. Two major photoproducts were identified in all cases. Under indoor conditions half-lives of chlorsulfuron were 92 hr in methanol, 78 hr in distilled water but only 18 hr in natural creek water. On silica gel the half-life was 60 hr while on montmorillonite powder the half-life was slightly prolonged (66 hr). This ranking of the photostability in different media was confirmed by a series of outdoor experiments under solar radiation conditions. Assuming first order kinetics the half-life times were calculated as 186 hr for distilled water, 31 hr for creek water, 136 hr for silica gel and 115 hr for montmorillonite. The stability of chlorsulfuron in methanol or water can be easily explained by the ultraviolet spectra of the compound. The significant accelerated breakdown rate in creek water samples must be due to their content of photosensitizing agents or to the generation of OH-radicals and other reactive species. (Moore-IVI)
W86-01849

RING TEST OF A METHOD FOR ASSESSING THE PHOTOTRANSFORMATION OF CHEMICALS IN WATER,
European Chemical Industry Ecology and T9oxicology Centre, Brussels (Belgium).
J. Lemaire, J. A. Guth, O. Klais, J. Leahey, and W. Merz.
Chemosphere, Vol. 14, No. 1, p 53-77, 1985. 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Photochemistry, *Pentachlorophenol, *Dichlorophenol, *Dichloroaniline, *Nitrophenol, Phenols, Anilines, Fate of pollutants, Computers.

Seven types of apparatus have been used to measure the quantum yields for direct phototransformation in water of 4 chemicals (pentachlorophenol; 2,4-dichlorophenol; 3,4-dichloroaniline; 4-nitrophenol) under polychromatic (12 laboratories) and monochromatic (3 laboratories) light, according to a common test protocol. The results with both types of light were in good agreement. The reproducibility and accuracy of quantum yields obtained with the ECETOC/University of Clermont-Ferrand apparatus with polychromatic light (6 laboratories) were similar to or better than those obtained with monochromatic light. A disadvantage of the method with polychromatic light is that the calculation is more complicated, but this can be overcome by the use of a desk-top computer. On the other hand experiments with polychromatic light permit the determination of quantum yields of substances of low photo-reactivity. (Author's abstract)
W86-01850

EFFECT OF HYDROCARBON MIXTURES ON ADSORPTION OF SUBSTITUTED NAPHTHALENES BY CLAY AND SEDIMENT FROM WATER,
Virginia Inst. of Marine Science, Gloucester Point.
W. G. MacIntyre, and P. O. deFur.
Chemosphere, Vol. 14, No. 1, p 103-111, 1985. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Naphthalenes, *Hydrocarbons, *Adsorption, Clay, Sediments, Fuel, Fate of pollutants, Mixtures, Isotherms.

Similarity of adsorption coefficients for a compound from hydrocarbon mixtures in water solution and from the single compounds in water solution would indicate that different hydrocarbons at low concentrations do not compete for adsorption sites when surface coverage is imcomplete, and that the hydrocarbons do not interact in aqueous solution. Adsorption of methyl and dimethyl napthalenes, and of these compounds as components of JP8 aviation fuel and synthetic jet fuel mixtures, was measured on two sediments and montmorillonite clay in water. Isotherms were linear, and hydrocarbons of similar structure gave similar adsorption coefficients on a particular clay or sediment. Individual component adsorption co-

efficients were dependent upon mixture composition, but coefficients usually varied by less than a factor of two. This implies that single component adsorption coefficients may be adequate for use in environmental fate models of hydrocarbon mixtures. It is probable that results obtained pertain to mixtures containing other non-polar solutes such as chlorinated hydrocarbons. (Moore-IVI)
W86-01852

FATE AND TOXICITY OF HIGH DENSITY MISSILE FUELS RJ-5 AND JP-9 IN AQUATIC TEST SYSTEMS,
Georgia State Univ., Atlanta. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-01854

EFFECT OF FLOOD CONDITIONS ON THE GROUNDWATER QUALITY OF A BOREHOLE AT BARODA NEAR CRADOCK, EASTERN CAPE PROVINCE,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
E. A. W. Tordiffe, W. A. Van Der Westhuizen, and H. De Bruiyn.
Water S. A., Vol. 11, No. 1, p 33-34, January, 1985. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Floods, *Groundwater pollution, *Baroda, *South Africa, Irrigation effects, Chlorides, Sulfates, Sodium, Salts.

Analyses of groundwater samples taken at various time intervals over a period of several months from a single borehole, proved that significant changes in the inorganic quality occurred after periods of extreme flood conditions. The main changes which occurred, one and a half months after devastating floods, were an increase in the Cl(-), SO4(2-) and Na(+) concentration, while only a slight decrease in the HCO3(-) concentration was detected. This phenomenon is attributed to accumulation of salts in the soils and rocks above the groundwater table during normal conditions and the flushing thereof due to extremely wet conditions. The present practice of over-irrigation in the area due to readily available Orange River water could simulate similar flood conditions. (Author's abstract)
W86-01860

WATER QUALITY OF A SMALL URBAN CATCHMENT NEAR DURBAN, SOUTH AFRICA,
Durban-Westville Univ. (South Africa). Dept. of Geography.
G. du T. De Villiers, and E. Malan.
Water S. A., Vol. 11, No. 1, p 35-40, January, 1985. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Water pollution sources, *Catchment area, *Urban areas, *South Africa, Water quality, Wastewater pollution, Dissolved solids, Sodium, Chlorides, Ammonium, Industrial wastes, Swimming pools.

A preliminary study of baseflow water quality was conducted at a small urban catchment about 15 km northwest of Durban, South Africa. An attempt was made to explain the variations in anion and cation concentrations through on site inspections and discussions with the relevant local authorities. The geological formations in the catchment, consisting mainly of Table Mountain Sandstone, have a limited effect on the water quality. Pollution in the catchment is rather the determining agent. Mineralization of the surface waters is still reasonably low, with the mean total dissolved solids for the period at all the sampling points at 185 mg/l. The waters are dominated by sodium with the relative concentrations Na>Ca>Mg>K. The relatively high chloride content measured at some stations in a residential area could possibly be attributed to swimming pool effluent. The high SO4 concentration at one station is due to spillage by at least two industrial concerns. The relatively high NH4-N concentration at some sampling stations could be due to spillage from an industry and seepage from sewerage overflow. (Moore-IVI)
W86-01861

CHEMICAL COMPOSITION OF TRANSKEI RIVER WATER,
Durban-Westville Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-01862

DEPOSITION AND PROCESSING OF AIRBORNE NITROGEN POLLUTANTS IN MEDITERRANEAN-TYPE ECOSYSTEMS OF SOUTHERN CALIFORNIA,
Pacific Southwest Forest and Range Experiment Station, Riverside, CA.
P. J. Riggan, R. N. Lockwood, and E. N. Lopez.
Environmental Science and Technology, Vol. 19, No. 9, p 781-789, 1985. 5 Fig, 5 Tab, 42 Ref.

Descriptors: *Air pollution, *Nitrates, *Atmospheric deposition, *California, Water pollution sources, Groundwater pollution, Streamflow, Throughfall, Precipitation, Fire, Chaparral, Grasslands.

Atmospheric nitrogen deposition, associated with chronic urban air pollution, has produced stream water nitrate concentrations as high as 7.0 mg of N/L in chaperral watersheds in the San Gabriel Mountains of Los Angeles County, CA. Stream water NO3(-) concentration and discharge were greatest at high flow and may contribute significantly to existing groundwater NO3(-) pollution. Annual NO3(-) discharge ranged from 0.04 to 10.0 kg of N/ha over 4 years. Canopy throughfall and precipitation inputs of 23.3 and 8.2 kg of N/ha/year were high relative to other undisturbed ecosystems nationwide. Dry deposition was apparently a major source of the throughfall nitrogen. NO3(-) concentrations from nearby, relatively unpolluted watersheds were lower by 1-3 orders of magnitude. NO3(-) yield was elevated on watersheds where chaparral was converted to grassland in 1960 and may be greatly accelerated after wildfire because of high postfire NH4(+) concentrations and rapid nitrification in terrestrial and aquatic ecosystems. (Author's abstract)
W86-01868

SORBENT CONCENTRATION EFFECTS IN LIQUID/SOLID PARTITIONING,
Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
T. C. Voice, and W. J. Weber.
Environmental Science and Technology, Vol. 19, No. 9, p 789-796, 1985. 8 Fig, 4 Tab, 22 Ref.

Descriptors: *Lake sediments, *Sorption, *Model studies, *Partition coefficients, Lake Michigan, Hexachlorobiphenyl, Trichlorobiphenyl, Naphthalene, Chlorobenzene, Organic matter.

Partition coefficients developed in laboratory sorption studies have been observed to vary inversely with the concentration of sorbent solids utilized in the experimental system. A model was developed that relates this phenomenon to the complexation, or binding, of the solute by nonseparable organic matter in the liquid phase, and the subsequent sorption of both free and bound solute. It can be shown that linear partitioning in the resulting bisolute system can produce the nonlinear sorption anomalies that have been observed in isotherm studies. The model was calibrated to previously reported sorption data involving four hydrophobic environmental contaminants - 2,4,5,2',4',5'-hexachlorobiphenyl, 2,5,2'-trichlorobiphenyl, naphthalene, and chlorobenzene - and three Lake Michigan sediment samples. The strengths and weaknesses of the model along with its environmental implications are discussed. (Author's abstract)
W86-01869

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, W. L. Reichert, J. E. Stein, D. W. Brown, and H. R. Sanborn.
Environmental Science and Technology, Vol. 19, No. 9, p 836-841, 1985. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Benthic fauna, *Bioavailability, *Biotransformation, *Aromatic compounds, *Hydrocarbons, Estuarine environment, Sediments, Urban areas, Benzo(a)pyrene, Crustaceans, Clams, Shrimp, Fish, Metabolism.

Phylogenetically diverse benthic organisms (amphipods (Rhepoxynius abronius and Eohaustorius washingtonianus); clams (Macoma nasuta); shrimp (Pandalus platyceros); fish (Parophrys vetulus)) were exposed to an urban estuarine sediment (16 ppm of two to six benzenoid ring aromatic hydrocarbons (AHs)) to which trace amounts of (H-3)benzo(a)pyrene (BaP) were added. The techniques used to assess uptake and metabolism of AHs were gas chromatography/mass spectrometry (GS/MS) for AHs, high-pressure liquid chromatography/fluorescence spectrometry for AH metabolites in fish bile, and radiometric analyses for biotransformation of (H-3)BaP. Generally, the extent of metabolism of (H-3)BaP (M. nasuta < E. washingtonianus < R. abronius < or = P. platyceros approximately = P. vetulus) was negatively correlated to tissue concentrations of AHs (three to six ring), except that amphipod species accumulated higher concentrations of AHs than did clams, indicating, that other factors (e.g., feeding strategy and rate of excretion) also influenced accumulation of AHs. Radiometric and GC analyses for BaP in both sediment and tissues suggested that not all of the BaP (and presumably other AHs) extracted chemically from sediment was bioavailable. (Author's abstract)
W86-01873

CHLORINATED HYDROCARBON CYCLING IN THE BENTHIC NEPHELOID LAYER OF LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. E. Baker, and S. J. Eisenreich.
Environmental Science and Technology, Vol. 19, No. 9, p 854-861, 1985. 6 Fig, 2 Tab, 31 Ref. NOAA project R/Cl-10, NOAA grant NA83AA-D-00056, EPA grant Cr 810274.

Descriptors: *Benthic nepheloid layer, *Chlorinated hydrocarbons, *Lake Superior, Path of pollutants, Polychlorinated biphenyls, DDE, Hexachlorobenzene, Resuspension, Lake sediments.

The dynamics and composition of the benthic nepheloid layer (BNL) in western Lake Superior were studied with respect to the cycling of trace hydrophobic organic compounds. The BNL was enriched in t-PCB, p,p'-DDE, and hexachlorobenzene (HCB) but deficient in dissolved organic carbon relative to surface waters. Resuspension events in midsummer resulted in a 50% increase in the PCB burden in the water column. Seasonal cycling of PCB congeners was strongly dependent on their degree of chlorination, with heavier chlorinated congeners lost from the water column (t1/2 = 17-28 days at two sites). Steady-state t-PCB concentrations in the BNL were maintained over the summer by transport of lighter chlorinated congeners from the underlying sediments. DDE is an effective tracer of sediment resuspension in Lake Superior. Recycling of trace organic pollutants in the BNL serves to increase their residence times in the lake. (Author's abstract)
W86-01875

LAGRANGIAN MULTI-LEVEL MODEL OF TRANSPORT, TRANSFORMATION AND DEPOSITION OF ATMOSPHERIC SULFUR DIOXIDE AND SULFATE,
Akademie der Wissenschaften der DDR, Leipzig. Forschungsstelle fuer Chemische Toxikologie.
E. Renner, U. Ratzlaff, and W. Rolle.
Atmospheric Environment, Vol. 19, No. 8, p 1351-1359, 1985. 6 Fig, 3 Tab, 16 Ref, 1 Append.

Descriptors: *Lagrangian transport model, *Path of pollutants, *Sulfur dioxide, *Acid deposition, *Acid rain, Model studies, Sulfates, Precipitation, Air pollution, Water pollution sources.

A multi-level Lagrangian atmospheric model for transport, transformation and dry and wet deposition of sulfur dioxide and sulfate is described. All processes are assumed to be reactions of the first order. The rate constants vary diurnally and seasonally with different meteorological conditions. The variability of the concentration in the surface layer was demonstrated by two examples, near the source. In one, dispersion within 100 km of a source is considered and in the other the variation in airborne fraction of S during long-range transport is calculated. This gives some insight into the necessarily complex considerations required in order to obtain optimal arrangements for environmental protection when near- and far-field source regions are operating at the same time. The model can be used in a simple programmable desk calculator without too much expense. (Baker-IVI)
W86-01883

RADIO-TELEMETRY AS AN AID TO ENVIRONMENTAL CONTAMINANT EVALUATION OF MOBILE WILDLIFE SPECIES,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7B.
W86-01886

CONTAMINANT RESIDUES IN FISH AND SEDIMENTS FROM LAKES IN THE ATCHAFALAYA RIVER BASIN (LOUISIANA),
Columbia National Fisheries Research Lab., MO.
R. V. Winger, and J. K. Andreasen.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 15, p 579-586, September, 1985. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Fish, *Lake sediments, *Pesticide residues, *Metals, *Atchafalaya River Basin, *Louisiana, Land use, Agriculture, Overflow, DDT, BHC, Polychlorinated biphenyls, Water pollution sources, Animal tissues.

Conversion of bottomland hardwood forests to agricultural land has reduced habitat and water quality in many lakes in the floodplain of the lower Mississippi River. The objectives of this study were to ascertain current contaminant residue concentrations in fish and sediment from lakes in the Atchafalaya River Basin and to determine the influence of overflow and agricultural land use on contaminant levels. Fish and sediment samples were collected from eight lakes that differed in overflow (no overflow, headwater overflow, backwater overflow) and land-use characteristics (presence or absence of agricultural land). Residue analysis of 24 sediment and 82 fish samples collected from the study lakes showed that contaminant residues were uniformly low. Total DDT concentrations, consisting mainly of DDE, were found in 98% of the fish samples and generally were the highest residues though they rarely exceeded 0.05 micro-g/g. Dieldrin, alpha-BHC and gamma-BHC, in concentrations rarely exceeding 0.05 micro-g/g, were detected in about 50% of fish samples. Total organochlorine pesticide and PCB residues were less than 2.00 micro-g/g in all fish from all lakes, except for a 3.46 micro-g/g total in spotted gar (Lepisosteus oculatus) from one lake. Sediments were free from pesticide residues except for occasional traces (0.01 micro-g/g) of alpha-BHC. Metal residue concentrations in fish and sediment samples were typical of uncontaminated areas. Lake systems in the Atchafalaya River Basin appeared to be relatively uncontaminated by agricultural pesticides, but metal and organic residues in fish were similar from lakes with the same land-use and overflow characteristics. (Author's abstract)
W86-01890

CONTAMINANTS IN FISH FROM GREAT LAKES HARBORS AND TRIBUTARY MOUTHS,
Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
D. S. DeVault.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 587-594, September, 1985. 4 Tab, 16 Ref.

Descriptors: *Great Lakes, *Pesticides, *Priority pollutants, *Fish, Polychlorinated biphenyls, Chlorinated hydrocarbons, Aromatic compounds, Aliphatic compounds, Benzene compounds, Rivers, Tributaries, Harbors.

Composite fish samples collected from Great Lakes harbors and tributaries between 1980 and 1981 were analyzed by gas chromatography and gas chromatography-mass spectrometry for a wide range of pesticides and priority pollutants. Severe polychlorobiphenyl (PCBs) contamination was observed in Sheboygan River fish with moderate to severe PCB contamination in samples from the Milwaukee, Kinnickinnic, Fox, and Ashtabula Rivers. The Ashtabula River samples also contained several chlorinated aromatic and aliphatic hydrocarbons. Polynuclear aromatic hydrocarbons were detected in fish from the Black, Kinnickinnic and Menominee Rivers, while a number of benzene derivatives were observed in samples from the Fox and Wolf Rivers. (Author's abstract)
W86-01891

TEMEPHOS RESIDUES IN STAGNANT PONDS AFTER MOSQUITO LARVICIDE APPLICATIONS BY HELICOPTER,
Environmental Research Lab., Gulf Breeze, FL.
E. M. Lores, J. C. Moore, P. Moody, J. Clark, and J. Forester.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 308-311, September, 1985. 2 Fig, 10 Ref.

Descriptors: *Temephos, *Pesticide residues, *Water analysis, *Water pollution effects, Water pollution sources, Insecticides, Organophosphorus compounds, Organic compounds.

The concentrations of temephos in water were measured so that the application rates could be confirmed for this organophosphate insecticide to control mosquito larvae. Results are reported from residue analysis of water from two stagnant ponds following actual field applications of larvicide by helicopter at treetop level in South Florida. Site 1 was less than 0.05 ha in surface area, less than 10 cm deep, and completely covered by a tree canopy. Site 2 was greater than 0.5 ha in surface area, less than 10 cm deep and the canopy was open in the middle. The recommended application rate on the label of the 4-E formulation for mosquito larvae control is 0.5 to 1.5 fl oz/acre. Calculated residue concentrations for the intended 1 oz/acre application rate used in the study range from 250 micro-g/l for water that is 1 inch deep to 42 micro-g/l for waters that are 6 inches deep. These calculations predict concentrations of temephos that are very close to the measured concentration found immediately after the sprays. Field test results indicate that the pesticide remains intact in water up to 48 hours, and residues as high as 62 micro-g/l are found. A problem of stabilization in this study was overcome by using mineral oil as an extracting solvent until the samples could be returned to the laboratory. (Baker-IVI)
W86-01897

ORGANOCHLORINE HYDROCARBON RESIDUES IN SEDIMENTS OF TWO DIFFERENT LAGOONS OF NORTHWEST MEXICO,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
M. T. L. Rosales, R. L. Escalona, R. M. Alarcon, and V. Zamora.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 322-330, September, 1985. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Lagoons, *Mexico, *Yavaros lagoon system, *Huizache-Caimanero lagoon system, *Sediments, *Organic compounds, *Chlorinated hydrocarbons, Hydrocarbons, Salinity, Seasonal variation, Pesticide residues, DDT.

Sediment samples were collected seasonally during a 21 month period from the Yavaros lagoon system in Sonora Mexico and the Huizache-Caimaneros lagoon system in Sinaloa Mexico. The concentration of organochlorine residues at each sampling station was determined. Higher concentrations of organochlorine compounds in the Yavaros area were usually found from October to January. However there was not a clear distribution pattern. The highest values observed were: HCH 10.45, heptachlor 5.4, aldrin 1.85, heptachlor epoxide 4.29, dieldrin 5.85, and total DDT 7.62 micro-g/kg. The values are higher in Moroncarit lagoon and in the estero linking Moroncarit and Yavaros lagoons. Yavaros lagoon has a uniform salinity of about 37% which reflects a high marine influence. Organochlorine hydrocarbons concentration in the Huizache-Caimanero system is higher in July. The concentration of these compounds apparently follows an annual cycle which is related to the evaporation-precipitation cycle of these lagoons. The persistence of HCH in submerged tropical soils is not very long due to the microflora degradation of this compound. The cycling presence of DDT in the Huizache-Zaimanero system was unexpected. The levels of organochlorine compounds determined in the areas studied are within the same order of magnitude as those reported earlier. Total DDT values ranged from 3 to 21 micro-g/kg. (Baker-IVI)
W86-01899

EFFECTS OF GUT SEDIMENT CONTENTS ON MEASUREMENT OF METAL LEVELS IN BENTHIC INVERTEBRATES - A CAUTIONARY NOTE,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman.
Bulletin of Environmental Contamination and Toxicoloy, Vol. 35, No. 3, p 345-347, September, 1985. 1 Tab, 5 Ref.

Descriptors: *Sediments, *Metals, *Invertebrates, *Benthic fauna, Copper, Zinc, Lead, Iron, Manganese, Nickel, Cobalt, Tubificids, Larvae, Lampreys, Midges.

Sediments were collected subtidally in the Lower Fraser River, British Columbia for metal analysis. Three groups of organisms were collected in sufficient biomass for heavy metals analysis. Gut sediment weight of tubificids averaged 14.99% of total weight, however the metal load contributed by the gut sediment varied from a mean value of 16.4% for zinc to a mean value of 39.7% for nickel. In the case of ammocoetes larvae, average gut sediment weight was less than that for tubificids, but the metal load contributed by this sediment was much higher than in tubificids. Values varied from a mean of 20.7% for zinc to a mean of 62.0% for lead. Chironomid larvae were only occasionally collected so the sample size is small, but gut sediment metal contents also comprised a high percentage of the total metal load. It is important that digestions of whole benthic animals for tissue metal analysis include a gut sediment correction. (Baker-IV)
W86-01902

SUPERFICIAL ACCUMULATION OF HEAVY METALS IN NEAR SHORE MARINE SEDIMENTS: AN OBJECTIVE INDEX OF ENVIRONMENTAL POLLUTION,
Instituto de Investigaciones Pesqueras, Cadiz (Spain).
R. Establier, A. Gomez-Parra, and J. Blasco.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 348-353, September, 1985. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Bay of Cadiz, *Spain, *Heavy metals, *Marine sediments, *Sediments, Vertical distribution, Fate of pollutants, Zinc, Manganese, Iron, Copper, Lead, Cadmium, Salt ponds, Aquaculture.

The effect of civilization has been evaluated in the Bay of Cadiz, Spain. This area represents a densely populated and relatively enclosed coastal zone having a special interest due to the use of its salt ponds as fish farms. The vertical distribution of six heavy metals and other complementary parameters were studied at a few sampling-stations, chosen as representative sedimentary environments of this zone. A Superficial Enrichment Factor was established. In general, the content of organic carbon

and heavy metals in the sediments of this zone appeared to be determined by the granulometry of the bottom, although the vertical trend of these parameters is conditioned by the proximity of the sample station to the outlets of the urban and industrial effluents of the area. The most pronounced concentration gradients of metals correspond to the northern area, where the greater number of effluents are located. The progressive reduction with depth of typically polluting metals occurs to some extent in all the sampling stations, and an extremely complex situation was found in the more superficial layer, mainly due to changes in the redox conditions of the environment. The Superficial Enrichment Factors Values are quite variable depending on the metal and the sampling station considered. The quantities of iron and manganese have not increased greatly in recent years. In the salt ponds the influence of anthropogenic activity was similar to other places where the movement of the water is not restricted. The complex hydrodynamics of the area may give rise to anomalous distributions for some heavy metals. (Baker-IVI)
W86-01903

ABSORPTION OF CU++ BY LONG-TERM CULTURES OF DUNALIELLA SALINA, D. TERTIOLECTA, AND D. VIRIDIS,
Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-01904

ATRAZINE HYDROLYSIS IN SOILS: CATALYSIS BY THE ACIDIC FUNCTIONAL GROUPS OF FULVIC ACID,
Department of Agriculture, Ottawa (Ontario). Chemistry and Biology Research Inst.
D. S. Gamble, and S. U. Khan.
Canadian Journal of Soil Science, Vol. 65, No. 3, p 435-443, August, 1985. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Atrazine, *Hydrolysis, *Fulvic acid, *Soil water, *Fate of pollutants, Herbicides, Humic substances, Soil solution, Mathematical equations.

The catalysis of atrazine hydrolysis at 25.0 C by the types of acidic functional groups found in humic materials has been investigated. No evidence of catalysis by carboxylate ions was observed. From a knowledge of the types and number of acid functional groups in a quantitatively characterized fulvic acid, and the distributions of their KA values it was found that hydrogen ions and undissociated carboxyl groups were the only catalytic agents. The carboxyl groups have a second-order k sub AH of 7.88/days/M. Weakly acidic functional groups having Ka approximately = 10 to the 10th power showed no catalysis. A predictive equation has been produced for the half-life of atrazine in fulvic acid solutions at 25.0 C. It represents a general class of equations which should permit the practical prediction of atrazine persistence in soil solutions and other natural waters. (Author's abstract)
W86-01907

DISSOLVED COLOURED COMPOUNDS AND SUSPENDED MATTER IN THE WATERS OF THE MIDDLE WAIKATO RIVER,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
M. H. Timperley.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 63-70, 1985. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Suspended solids, *Color, *Waikato River, *New Zealand, Aromatic compounds, Turbidity, Hydroelectric plants, Organic compounds, Industrial wastewater, Pulp wastes.

Concentrations of suspended matter and filtrable hydroxylated aromatic compounds (HAC) together with turbidity and light absorbance measurements at 270 and 750 nm are reported for monthly samples, over one year, of water from the tailraces of the nine hydroelectric power stations on the Waikato River, North Island, New Zealand. Between Lakes Aratiatia and Karapiro the suspended matter concentrations increase 3-fold. The concentrations of HAC increase only slightly in all lakes except Lake Maraetai where a 3-fold increase occurs because of Kraft bleach effluent from the New Zealand Forest Products Limited, Kinleith Mill. This effluent also causes a marked increase in the absorbance at 270 nm, a measure of the brown color attributable to dissolved organic compounds. The HAC in the effluent are linearly related to absorbance at 270 nm. The use of these easily measured parameters for detecting changes in water appearance, i.e., color and clarity, are discussed. Measurements of light scattering, either turbidity or absorbance, appear to have sufficient sensitivity to detect changes in relative water clarity. The ratio of inorganic to organic suspended matter increases down the river and measurements of these two components could be used to detect changes in water appearance resulting from changes in the suspended matter composition. The absorbance at 270 nm of filtered water is a convenient and sensitive indicator of dissolved color but a range of unidentified compounds contribute to this absorbance and for control of the brown coloration caused by timber processing effluents, limits on the discharge of HAC may be more useful. (Author's abstract)
W86-01912

LEACHING STUDY OF OIL SHALE IN KENTUCKY WITH A SECTION ON HYDROLOGIC RECONNAISSANCE OF THE OIL SHALE OUTCROP IN KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
S. S. Leung, D. W. Leist, R. W. Davis, and S. Cordivola.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4073, 1984. 68 p, 18 fig, 23 tab, 48 ref.

Descriptors: *Oil shale, *Leaching, *Groundwater, *Surface water, *Water quality, Geology, *Kentucky, Knobs physiographic region, Groundwater movement, *Water pollution sources.

Oil shales in Kentucky are rocks of predominantly Devonian age. The most prominant are the Ohio, Chattanooga, and New Albany Shales. A leaching study was done on six fresh oil shale samples and one retorted oil shale sample. Leaching reagents were distilled water, 0.0005 N sulfuric acid, and 0.05 N sulfuric acid. The concentration of constituents in the leachates were highly variable. The concentration of sodium, manganese, and zinc in the retorted shale leachate was several orders of magnitude higher than those of the leachates of fresh shale samples. The major oil shale outcrop covers approximately 1,000 square miles in a horseshoe pattern from Vanceburg, Lewis County, in the east, to Louisville, Jefferson County, in the west. The Kentucky, Red, and Licking Rivers cross the outcrop belt, the Rolling Fork River flows along the strike of the shale in the southwest part of the outcrop, and the Ohio River flows past the outcrop at the ends of the horseshoe. Oil shale does not appear to significantly alter the water quality of these streams. Oil shale is not an aquifer, but seeps and springs found in the shale indicate that water moves through it. Ground water quality is highly variable. (USGS)
W86-01918

GROUND-WATER QUALITY IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-01919

5C. Effects Of Pollution

EVALUATION ON POLLUTION IN THE XIANG JIANG RIVER BY USING ZOOBENTHOS,
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 7B.
W86-01323

SPECIES DIVERSITY OF ALGAL FLORA IN VISHWAMITRI RIVER, BARODA (INDIA),
S.S.V.P. Santha's Science Coll., Dhule (India). P.G. Dept. of Botany.
For primary bibliographic entry see Field 5A.
W86-01325

RECONSTRUCTION OF LONG-TERM TIME SERIES FOR COMMERCIAL FISHERIES ABUNDANCE AND ESTUARINE POLLUTION LOADINGS,
Martin Marietta Environmental Systems, Columbia, MD.
J. K. Summers, T. T. Polgar, J. A. Tarr, K. A. Rose, and D. G. Heimbuch.
Estuaries, Vol. 8, No. 2A, p 114-124, June, 1985. 7 Fig, 2 Tab, 37 Ref.

Descriptors: *Estuaries, *Fish populations, *Water pollution effects, *Fisheries, Time series analysis, Climate, Statistical studies.

Time series were developed for five target estuaries and 35 target fisheries using as much of the existing data as can be found on commercial landings, fishing effort, pollution loadings, developmental activities, and habitat alterations. Missing data points from climatic and pollution time series were estimated by statistical modeling, interpolation, and assumption. A probabilistic method was developed to estimate relative stock abundance for each target species-estuary combination using estuarine-specific landings, regional landings, regional catch-by-gear, and regional effort. Based on overall literature, ecological and economic effects on commercial fisheries and fishing resources probably result from climatic variations. (Baker-IVI)
W86-01331

INVESTIGATION OF RELATIONSHIPS AMONG POLLUTANT LOADINGS AND FISH STOCK LEVELS IN NORTHEASTERN ESTUARIES,
Martin Marietta Environmental Systems, Columbia, MD.
T. T. Polgar, J. K. Summers, R. A. Cummings, K. A. Rose, and D. G. Heimbuch.
Estuaries, Vol. 8, No. 2A, p 125-135, June, 1985. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Potomac River, *Fish populations, *Time series analysis, *Water pollution effects, Estuaries, Fish, Climates.

Time series analysis by regression of categorical variables seems promising for investigating pollutant effects on stocks. The method developed here is attractive in that it yields comparative and probabilistic measures of pollutant effects relative to other population control factors. Additionally, categorical regression models seem to explain a respectable amount of stock variability, given the limited reliability of landings, effort, and pollutant data. These types of analyses will be extended to other species, pollutants, and estuaries as the project progresses. In the current study the categorical time series regressions were used to derive preliminary relationships among previous levels of stock size, climatic variables, and pollution indicators. The analysis technique evaluated hypotheses on the effects of human population changes and dredging activity on stock histories of the Potomac estuary's striped bass and American shad, for the period 1929 through 1976. While climatic factors dominate striped bass dynamics compared to the two pollution variates tested, the American shad stock showed strong dependence on human population levels, but not on dredging activity, compared to climatic factors. (Baker-IVI)
W86-01332

ABUNDANCE FLUCTUATIONS AMONG BENTHIC INVERTEBRATES IN TWO PACIFIC ESTUARIES,

Geological Survey, Menlo Park, CA.
F. H. Nichols.
Estuaries, Vol. 8, No. 2A, p 136-144, June, 1985. 4 Fig, 40 Ref. DOE contract DE-AT06-76EV-75026-96.

Descriptors: *Estuaries, *Invertebrates, *Benthic animals, Population dynamics, Water pollution effects, Puget Sound, San Francisco Bay.

Contrasting time scales and mechanisms of structural variations within two benthic communities were examined using long term studies. The usefulness of such long data sets for evaluating human impact on a given area were also examined. Large short-term variations in species abundances within a community composed predominantly of opportunistic species were revealed in a 10 year study of a San Francisco Bay mudflat. This particular study site is located in a highly urbanized estuary where it is influenced by a nearby sewage treatment facility. Rapid changes in population size of the common species impedes the detection of anthropogenic influences on community composition. Only very long term data sets may provide evidence of progressive changes. Numerical abundance of the common species also change markedly as evidence by data collected for a 20 year period on the benthic community at 200 m depths in the main basin of Puget Sound. This environment is subject to little apparent habitat disturbance. Numerical dominance shifts from one species to another at irregular, multiyear intervals. Recent increases in two heretofore rare species, and a significant increase in total numbers of individuals suggest that long term changes may be occurring in this community. The importance of measuring both the amplitude and the periodicity of fluctuations in population size of aquatic species as well as long term fluctuations and patterns in environmental factors before attempting to demonstrate the effect of anthropogenic influences on aquatic communities is demonstrated by these two long term data sets. The usefulness of long term data sets for revealing the potential importance of interactions among species in determining abundance patterns in the soft-bottom benthos is demonstrated. (Baker-IVI)
W86-01333

EUTROPHICATION AND MANAGEMENT INITIATIVES FOR THE CONTROL OF NUTRIENT INPUTS TO RHODE ISLAND COASTAL LAGOONS,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
V. Lee, and S. Olsen.
Estuaries, Vol. 8, No. 2B, p 191-202, June, 1985. 2 Fig, 7 Tab, 60 Ref. NOAA grant NA-79AA-D-00096, Federal Regional Council Grant FRC-JF-01-11.

Descriptors: *Eutrophication, *Lagoons, *Coastal waters, *Rhode Island, Nutrients, Water pollution control, Fisheries, Water pollution effects, Groundwater pollution.

The eutrophication of large coastal lagoons in Rhode Island is discussed including definition of the extent of the problem, identification of the sources of nutrient inputs and development of management initiatives. The lagoons, known locally as salt ponds, lie on the glacial outwash plain of Rhode Island's south shore and are separated from the sea by narrow coastal barriers. The nitrogen loadings per unit area of the salt ponds are 240-770 mml N per sq m per year. Nutrient enrichment of these lagoons has led to increased growth of marine macroalgae. This increased growth appears to alter the benthic habitat and shift it from a grazing to detrital food chain which is impacting on important shell fisheries. The major sources of nitrogen inputs to the salt ponds are identified as inorganic nitrogen inputs from streamflow, groundwater, runoff, precipitation and tidal inflow from offshore. The groundwater is the dominant pathway by which nitrogen enters the salt ponds. A series of management initiatives are proposed to limit inputs from present and potential development within the watersheds of the lagoons. These initiatives focus on two issues. The first is to reduce nutrient loadings from already densely developed areas. The second is to reduce the potential for further development in as yet sparsely developed areas within the watershed. The plans call for an aggressive program to maintain existing septic systems and to replace failing systems; to build and maintain settling basins for major sources of surface runoff; to limit extension of sewers into already densely developed areas; to restrict extension of water supply systems to within pond watershed boundaries so that future tie-ins do not withdraw substantial amounts of freshwater influx from one pond and divert it to another; to require buffer strips of natural vegetation around the shoreline of the ponds to minimize runoff and protect intertidal habitat; and to mount a sustained educational campaign to promote public appreciation for the problems and the need to support these measures. (Baker-IVI)
W86-01337

IMPACT OF DISCHARGES FROM SEAFOOD PROCESSING ON SOUTHEASTERN ESTUARIES,
Georgia Univ., Brunswick. Marine Extension Service.
K. W. Gates, B. E. Perkins, J. G. EuDaly, A. S. Harrison, and W. A. Bough.
Estuaries, Vol. 28, No. 2B, p 244-251, June, 1985. 2 Fig, 5 Tab, 20 Ref. National Sea Grant Program grant 04-8-M01-175.

Descriptors: *Georgia, *Food processing wastes, *Estuarine environment, Industrial wastes, Water pollution effects, Nutrients.

The effects of effluents on two of Georgia's estuarine systems were studied. The systems included a relatively undeveloped area consisting of three small estuarine creeks, two of which are normally exposed to seafood packing by-products, and a large commercially and industrially developed estuary that receives effluents from a seafood processing plant and three packing houses. The environmental impact of current seafood processing wastes on estuaries in Georgia appears to be minimal when compared with the natural organic load. The large estuary demonstrated a high residual capacity to receive processing effluents without significant change. The BOD load from shrimp thawing, peeling, sorting, and cleaning operations at the large seafood processing plant was shown to be equivalent to the organic material generated by a 302 sq m plot of salt marsh. NH4-N levels were greater than, but the same order of magnitude as, natural runoff from marsh land. (Baker-IVI)
W86-01340

EFFECTS OF CONTAMINANTS ON TOXICITY OF THE LAMPRICIDES TFM AND BAYER 73 TO THREE SPECIES OF FISH,
National Fishery Research Lab., La Crosse, WI.
L. L. Marking, and T. D. Bills.
Journal of Great Lakes Research, Vol. 11, No. 2, p 171-178, 1985. 4 Tab, 24 Ref.

Descriptors: *Great Lakes, *Lampricides, *Fish, *TFM, *Bayer 73, *Water pollution effects, Synergism, Fish management, Pesticides, Organic compounds, Pesticides, Metals, Industrial wastes, Tannic acid.

Nontarget fish were exposed to combinations of lampricides and contaminants that may be present in the Great Lakes basin, with the objectives of quantifying the additive toxicity of certain paired mixtures, demonstrating the effects of combining two or more selected pesticides, and calling attention to the potential hazards of applying chemicals in aquatic environments where contaminants already exist. The toxicities of combinations of lampricides with organic pesticides, metal, industrial or municipal pollutants, and tannic acid were mostly additive. The toxicity of a combination of TFM, Delnav, and malathion was synergistic, and extremely small quantities of each chemical became lethal when mixed. Toxicities of the pesticides in the combination also increased commensurately. The triple combination of chemicals produced extraordinary synergism and effectively demonstrated the hazards that may result if certain chemical combinations occur in the aquatic environment. Synergism is not the only kind of toxic action that produces hazards to aquatic organisms. All three types of toxic action are of concern because toxic units produced by contaminant chemicals add to the toxic units of applied management chemicals. Since the toxicity of the majority of chemical combinations is simply additive, this cumulative toxic action contributes more total units to aquatic environments than the extreme actions of less than additive and synergism. The toxicity of the lampricide TFM, as well as other management chemicals, is reinforced by the presence of any contaminant that contributes additional units of toxicity. (Baker-IVI)
W86-01349

NUTRIENT ENRICHMENT OF ESTUARINE SUBMERSED VASCULAR PLANT COMMUNITIES. 1. ALGAL GROWTH AND EFFECTS ON PRODUCTION OF PLANTS AND ASSOCIATED COMMUNITIES,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W86-01351

EFFECTS OF ENVIRONMENTAL AND BIOLOGICAL VARIABLES ON THE TOXICITY OF MERCURIC CHLORIDE,
D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
S. R. Verma, R. Chand, and I. P. Tonk.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 243-248, July, 1985. 4 Tab, 31 Ref.

Descriptors: *Toxicity, *Mercuric chloride, *Fish, Water pollution effects, Temperature effects, Dissolved oxygen, Acidity, Fish populations.

The effects of environmental and biological variables on the toxicity of mercuric chloride to the fish Notopterus notopterus were evaluated. Temperature, dissolved oxygen concentrations, acidity, and fish size play a major role in the toxicity of mercuric chloride, especially in bioassay tests. Thus these variables need special attention whenever the results of bioassay are given with reference to chemicals. This will also help in determining a more reliable tool for calculation of the maximum allowable toxicant concentration and application factor for chemicals to be used in the field. (Baker-IVI)
W86-01353

EFFECTS OF EFFLUENT OF MUNICIPAL WASTEWATER ON THE GROWTH OF PORPHYRA YEZOENSIS IN THE CASE OF STATIC CULTURE (IN JAPANESE),
Tokyo Univ. of Fisheries (Japan).
T. Maruyama, A. Miura, and T. Yoshida.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 51, No. 2, p 315-320, February, 1985. 9 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Porphyra, *Macrophytes, *Activated sludge, Salinity, Plant physiology, Plant growth, Absorbance spectra, Spectroscopy.

The effects of unchlorinated activated sludge effluent from a municipal sewage treatment plant on the growth of Porphyra yezoensis were investigated for different effluent dosages with different degrees of salinity by means of in vitro static culture. To clarify the effect of the effluent on the Porphyra thalli, the length of thalli and the absorbance spectra of living thalli were measured every two days. The number of dead cells in a thallus were counted using a microscope 10 days after the start of the culture, followed by a erythrosine staining. While increasing the effluent dosage to about 5% by volume, the relative length of thalli decreased rapidly and the number of dead cells quickly increased, and they were enhanced with the lower salinity. When the effluent dosages was above 5%, the relative length of thalli and the number of dead cell had a definite value for each degree of salinity. The absorbance spectra (350-750 nm) and absorbance ratio (567 nm/676 nm) of living thalli increased when the effluent dosage and

exposure time were increased. The above mentioned results suggest that the activated sludge effluent of municipal wastewater may have an adverse effect on the growth of Porphyra thalli. (Author's abstract)
W86-01363

INVESTIGATIONS ON PARAQUAT TOXICITY IN FISHES,
Jozsef Attila Univ., Szeged (Hungary). Dept. of Biochemistry.
J. Nemcsok, L. Orban, B. Asztalos, Z. Buzas, and A. Nemeth.
Water International, Vol. 1, No. 2, p 79-81, June, 1985. 5 Fig, 12 Ref.

Descriptors: *Herbicides, *Paraquat, *Fish, *Toxicity, Organic compounds, Agricultural chemicals, Water pollution effects, Enzymes.

The sensitivity of three fish species with different feeding habits to paraquat contamination was examined. Treatments with 1 and 10 ppm paraquat, respectively, increased the transaminase enzyme activity of all three fish species investigated to about the same extent. The treatment with 100 ppm (which due to its deadly effect lasted less than 15 minutes) did not result in measurable transaminase increase in any of the species. LDH and blood glucose level proportionally increased with respective paraquat concentration applied, including the lethal 100 ppm treatment. Asphyxia was one of the accompanying symptoms of the sudden death of fishes due to high paraquat concentration. Preceding their death, fish were air-breathing with difficulty and tried to jump out of the aquaria. Scarlet red discoloration of abdominal veins could be noted during post motem examination. The change of serum cholinesterase activity on paraquat treatment of various concentrations differed in two of the fish species; 10 ppm paraquat decreased it by 40% in carp and by 30% in silver carp. The 100 ppm lethal dose also decreased serum cholinesterase activity. The points of paraquat's attack and results of attack include injury of liver and kidneys, reduction of oxygen uptake capacity by damaging the epithelial cells of the gill, and inhibition of cholinesterase enzyme activity, thus causing serious problems to the nervous system. (Baker-IVI)
W86-01378

ACUTE AND SUBLETHAL EFFECTS OF ORGANOTIN COMPOUNDS ON AQUATIC BIOTA: AN INTERPRETATIVE LITERATURE EVALUATION,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
L. W. Hall, and A. E. Pinkney.
Critical Reviews in Toxicology, Vol. 14, No. 2, p 159-209, 1985. 5 Tab, 101 Ref.

Descriptors: *Toxicity, *Water pollution effects, *Reviews, *Organotin compounds, Organic compounds, Metals, Tin, Aquatic life, Zooplankton, Fish, Invertebrates, Phytoplankton, Marine environment, Estuarine environment, Bioaccumulation.

The objectives of this review were to collect, synthesize, and interpret acute and sublethal organotin toxicity data in both freshwater and estuarine-marine ecosystems; to present environmental water column and sediment concentrations of organotin compounds in both freshwater and estuarine-marine systems to facilitate interpretation of toxicity data; and to identify deficiencies in available data to recommend future research for assessing ecological effects of organotin compounds in aquatic systems. Organotin toxicity data were available with 4 phytoplankton species, 5 zooplankton species, 19 species of macroinvertebrates, and 11 fish species. Acute organotin toxicity was found to range from 0.0004 to 0.004 mg/l bis (tributyltin) oxide (TBTO) for several zooplankton species. Acute mortality data for macroinvertebrates ranged from 0.0005 mg/l TBTO for juvenile mysid shrimp, Metamysidopsis elongata, to 0.29 mg/l TBTO for the pacific oyster, Crassostrea gigas. Imposex occurred in the mud snail at TBTO concentrations below the LC50. Bioconcentration-depuration studies with macroinvertebrates were conducted with mud crabs and oysters. Mud crabs exposed to TBTO through both food and water accumulated higher concentrations when compared with exposure through water. The effects of interacting environmental parameters such as temperature and salinity on the toxicity of organotin compounds to macroinvertebrates was also evaluated. Ninety-six hour LC50s for adult estuarine and marine fish ranged fom 0.005 mg/l TBTO for sheepshead minnows to 0.036 mg/l TBTO for the sole. Bioconcentration-depuration studies with sheepshead minnow showed that TBTO did not reach equilibrium in various tissues after 58 days of exposure. Ninety-six hour LC50s for all trophic groups were found to range from 0.0004 to 0.29 mg/l TBTO. Zooplankton were the most sensitive group; bivalves the most resistant. Environmental concentrations of organotin compounds in estuarine and marine water ranged from not detectable to 0.00 mg/l. Higher concentrations of organotin compounds were found in harbor and marina areas. (Baker-IVI)
W86-01400

MORPHOMETRIC ANALYSIS OF THE RESPONSE OF ANABAENA FLOS-AQUAE AND ANABAENA VARIABILIS (CYANOPHYCEAE) TO SELECTED CONCENTRATIONS OF ZINC,
Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
J. W. Rachlin, T. E. Jensen, and B. E. Warkentine.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 395-402, July, 1985. 3 Fig, 4 Tab, 31 Ref.

Descriptors: *Anabaena, *Cyanophyta, *Zinc, *Metals, *Toxicity, *Algae, Water pollution effects, Electron microscopy, Plant physiology.

The toxicological responses of the fresh-water cyanophycean algae Anabaena flos-aquae and A. variabilis, to select concentrations of the essential cation zinc, were quantified by the techniques of stereological electron microscopic morphometry. The cation concentrations used were 20.6, 52.0, and 114.7 micro-M, which represented the 96-hr EC50 dose for A. variabilis and an equal bisection of a log scale above and below this concentration. The results indicated that the surface area of the thylakoids of A. flos-aquae were significantly increased after exposure to 114.7 micro-M Zn, and that there was a significant increase in the number of lipid bodies per cell. All test concentrations caused a significant reduction in both the numbers and relative volume of the cell's cyanophycin granules, but resulted in an increase in the cell's membrane limited crystalline inclusions. Both 52.0 and 114.7 micro-M Zn caused a significant increase in the surface area of the thylakoids of A. variabilis, but only the highest concentration caused an increase in the volume of the interthylakoidal spaces. The relative volume and numbers of lipid bodies of A. variabilis cells were increased by exposure to 52.0 micro-M Zn, and 114.7 micro-M Zn caused a significant increase in the relative volume and numbers of the cell's polyphosphate bodies. The significance of these results are discussed in terms of potential cellular detoxification mechanisms, which are important in the cell's ability to cope with the anthropogenic introduction into the aquatic environment of metal and industrial pollutants. (Author's abstract)
W86-01405

IDENTIFICATION OF FERRITIN AS A MAJOR HIGH MOLECULAR WEIGHT ZINC-BINDING PROTEIN IN THE TROPICAL ROCK OYSTER, SACCOSTREA CUCCULLATA,
Murdoch Univ. (Western Australia). School of Mathematical and Physical Sciences.
J. Webb, D. J. Macey, and V. Talbot.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 403-407, July, 1985. 3 Fig, 1 Tab, 25 Ref.

Descriptors: *Ferritin, *Zinc, *Proteins, *Animal physiology, *Oyster, *Water pollution effects, *Dampier, *Western Australia, *Australia, Mollusks, Iron, Copper, Metals.

The metal-binding proteins of the body mass of the tropical rock oyster Saccostrea cuccullata from the iron-ore shipping terminals near Dampier, Western Australia, have been separated by gel chromatography and analyzed for Zn, Fe, and Cu. Appreciable amounts of Zn (40%) and Cu (25%) were eluted in association with high molecular weight fraction (> 60,000 daltons), the major component of which was identified as the heat stable Fe-binding protein, ferritin (approx, mol. wt. 550,000), which also contains 95% of the Fe detected. Ferritin thus accounts for significant amounts of protein-bound Zn in this species and most probably in other bivalves containing elevated tissue levels of Zn. (Author's abstract)
W86-01406

MICROBIAL ASSAY FOR DETERMINING THE INFLUENCE OF PHYSICOCHEMICAL ENVIRONMENTAL FACTORS ON THE TOXICITY OF ORGANICS: PHENOL,
New York Univ., NY. Lab. of Microbial Ecology.
H. Babich, and G. Stotzky.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 409-415, July, 1985. 8 Fig, 31 Ref.

Descriptors: *Toxicity, *Phenol, *Fungi, *Physicochemical characteristics, Water pollution effects, Hydrogen ion concentration, Hardness, Salinity, Water temperature, Synergistic effects, Pesticides, Toxaphene, Cresols, Endrin aldehyde.

The toxicity of phenol to filamentous fungi was unaffected by pH or water hardness, but it was potentiated by salinity at levels comparable to those occurring in estuarine and off-shore marine waters. The effect of temperature on the response of the fungi to phenol was highly variable: depending on the fungus, the toxicity of phenol was either not affected, increased, or decreased as the temperature was raised from 22 to 32 C. The toxicity of phenol was not affected by heavy metals. The mediating influences of these abiotic environmental factors on the toxicity of phenol to filamentous fungi were similar to those reported for aquatic macrobiota. This similarity, which has also been noted with the effects of environmental factors on the toxicity of heavy metals, strengthens the concept of using microbial assays to evaluate initially the potential mediating influence of physicochemical factors of natural environments on the toxicity of organic pollutants. An antagonistic interaction in toxicity occurred between phenol and endrin aldehyde or p-chloro-m-cresol, and an additive interaction occurred between phenol and toxaphene, but no interactions were apparent between phenol and other phenolic compounds and pesticides. (Author's abstract)
W86-01407

COMPARATIVE ACUTE SENSITIVITIES OF EARLY LIFE STAGES OF ATHERINID FISHES TO CHLORPYRIFOS AND THIOBENCARB,
Environmental Research Lab., Gulf Breeze, FL.
P. W. Borthwick, J. M. Patrick, and D. P. Middaugh.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 465-473, July, 1985. 1 Fig, 6 Tab, 40 Ref.

Descriptors: *Grunion, *Silver-side, *Fish, *Toxicity, *Chlorpyrifos, *Thiobencarb, *Organophosphorus pesticides, Pesticides, Insecticides, Water pollution effects, Growth stages.

Sensitivity, expressed as the 96-hr LC50 derived from acute lethality tests, was compared for four ages (day-of-hatch, 7-day, and 28-day) of three atherinid fishes: Leuresthes tenuis (California grunion), Menidia menidia (Atlantic silver-side), and Menidia peninsulae (tidewater silver-side). Responses of each age-species combination exposed to the organophosphate insecticide chloropyrifos and the carbamate herbicide thiobencarb were compared in both static and flowing seawater toxicity tests. Chlorpyrifos was highly toxic to all atherinids (96-hr LC50's ranged from 0.4 to 6.7 micro-g/L); toxicity of thiobencarb was approximately two orders of magnitude lower (LC50 values from 199 to 1,405 micro-g/L). Responses to

each pesticide were similar among the three species. Sensitivity was generally highest for 7-day and 14-day age groups, and flowing water tests were more sensitive measures of toxicity than static tests, especially for chlorpyrifos. Comparisons of three computational methods indicate that probit and moving average methods calculate comparable LC50 estimates with the binomial method being the least uniform point estimator. (Author's abstract)
W86-01408

ORGANOCHLORINE CHEMICAL RESIDUES IN WHITE PELICANS AND WESTERN GREBES FROM THE KLAMATH BASIN, CALIFORNIA,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
D. E. Boellstorff, H. M. Ohlendorf, D. W. Anderson, E. J. O'Neill, and J. O. Keith.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 485-493, July, 1985. 1 Fig, 6 Tab, 39 Ref.

Descriptors: *Pelicans, *Grebes, *Klamath Basin, *Clear Lake, *California, *Animal tissues, *Birds, *Chlorinated hydrocarbons, DDT, DDD, Dieldrin, Polychlorinated biphenyls, Endrin, Pesticides, Insecticides, Eggs, Wildlife habitats.

Samples were analyzed for 12 organochlorine chemicals. Concentrations of DDT + DDD and dieldrin in American white pelican (Pelecanus erythrorhynchos) eggs collected at the Klamath Basin National Wildlife Refuges decreased from 1969 to 1981; DDE and polychlorobiphenyl (PCB) residues did not significantly change. Differences between PCB residues in eggs collected from Lower Klamath and Clear Lake colonies in 1969 suggest different migration routes or wintering areas between populations nesting at these two locations. White pelican and western grebe (Aechmophorus occidentalis) PCB/DDE ratios were 0.13 and 1.58, respectively, suggesting different exposure patterns. White pelican eggshell thickness increased between 1969 and 1981, but remained significantly less than pre-1947 values. Western grebe shell thickness was not significantly different from pre-1947 values. Endrin caused some of the pelican mortalities in the Klamath Basin from 1975 to 1981. Pelicans may have acquired endrin in California, but possibly from areas outside of the Klamath Basin. (Author's abstract)
W86-01409

EFFECT OF LETHAL COPPER SOLUTIONS ON THE BEHAVIOR OF RAINBOW TROUT, SALMO GAIRDNERI,
Concordia Univ., Sir George Williams Campus, Montreal (Quebec). Water Pollution Research Lab.
S. C. J. Pedder, and E. J. Maly.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 501-507, July, 1985. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Copper, *Metals, *Trout, *Fish, *Toxicity, *Fish behavior, Behavior, Water pollution effects, Fish food.

Experiments were performed on flow-through artificial stream apparatus to determine the attraction-avoidance responses of rainbow trout, Salmo gairdneri to lethal copper solutions (0.5, 0.75, 1.0, 2.0, 3.0 and 4.0 mg/L) when food was provided at a single source in the more contaminated water and when food was provided throughout the stream. Preference of groups of twenty test individuals for the experimental or control water was recorded at hourly intervals over 96 hr. At all concentrations, there was an initial attraction period for and subsequenct avoidance of the more highly contaminated waters. Attraction was greatest in tests employing higher concentrations (3.0 and 4.0 mg/L); this attraction led to high mortality. Belated avoidance of copper solutions was observed at all levels above 0.5 mg/L maximizing at 1.0 mg/L. The EC50-96-hr value for avoidance was between 0.5 and 0.75 mg/L. With food provided only in contaminated water, fish exhibited a prolonged and intense attraction period at the lower levels (0.5 to 2.0 mg/L) when compared to dispersed feeding. No significant differences between the feeding regimes existed at the higher copper levels. Mortality curves were similar in both feeding routines. Injured fish were found in the least contaminated waters. Tagging experiments indicate a movement pattern initially toward the toxicant, with subsequent reverse migration to cleaner waters. Little movement occurred during attraction and avoidance stages. Initial avoidance was not observed at any of the tested copper concentrations. Results indicate initial attraction at all concentrations may orientate fish toward the contaminant source, and subsequent avoidance behavior had little effect on survivorship rates. Observed trout behavior subsequent to copper discharges contributed to high mortality; behavioral response of organisms to toxicants must be incorporated into work attempting to set reasonable water-quality standards in natural water bodies. (Author's abstract)
W86-01410

SODIUM IN DRINKING WATER IN SOUTH CAROLINA,
South Carolina State Dept. of Health and Environmental Control, Columbia. Div. of Chronic Disease.
D. T. Lackland, M. C. Weinrich, F. C. Wheeler, and D. M. Shepard.
American Journal of Public Health, Vol. 75, No. 7, p 772-774, July, 1985. 2 Tab, 22 Ref. National Heart, Lung, and Blood Institute contract N01-HV-72987.

Descriptors: *Sodium, *Drinking water, *South Carolina, *Hypertension, Diet, Public health, Chemical composition, Calcium, Minerals, Blood pressure, Water quality.

Because of the reported variability between individuals in the percent of dietary sodium contributed by drinking water, the potential contribution of drinking water sodium to total consumption and to blood pressure levels was explored in a South Carolina population-based survey. The Carolina Health Survey was implemented in 1982 to obtain information on hypertension, health status, and health behaviors of non-institutionalized South Carolinians 18 age or older. For each of the 825 participating households, a 50 ml water sample was taken from the water source used for drinking and cooking purposes; sodium analysis was determined by the flame emission technique. Drinking water consumption was estimated at one liter per day. In the field, interviewers took blood pressure measurements from one adult in each household and administered a diet questionnaire. Most (96 per cent) of the population was served by drinking water containing < 100 mg/l Na (median 14.8 mg/l). For households with water sources containing > or = 100 mg/l Na, drinking water accounted for approximately 8.5 per cent of total estimated consumption. After adjustment for age, sex, race, body mass index, education, and dietary sodium, a negative association between diastolic blood pressure and drinking water sodium levels was found. No significant associations of dietary sodium with either systolic or diastolic BP were found. The linear discriminant analysis to assess drinking water and dietary sodium as identifiers of hypertensives showed no contribution for dietary sodium, but a statistically significant contribution for drinking water sodium ($p<.05$). It is suggested that the observed negative association between systolic and diastolic BPs and drinking water sodium is not simply due to chance but the association is causally improbable; the observed association may result from confounding by other minerals such as calcium. (Collier-IVI)
W86-01411

SOLUBILZATION EFFECTS OF SIMULATED ACID RAIN ON THE ORGANIC MATTER OF FOREST SOIL; PRELIMINARY RESULTS,
Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
G. W. Hay, J. H. James, and G. W. vanLoon.
Soil Science, Vol. 139, No. 5, p 422-430, May, 1985. 6 Fig, 3 Tab, 34 Ref. Canada Department of Supplies and Services contract ISU80-00350.

Descriptors: *Acid rain, *Water pollution effects, *Forest soils, *Organic matter, *Solubilization, Chemistry of precipitation, Acidity, Hydrogen ion concentration, Organic carbon, Nitrogen.

The concentrations of total organic carbon, total carbohydrate, fulvic acid, and ammonium-plus-amino nitrogen were determined in leachates from columns of a Canadian shield podzol soil at depths of approximately 10 and 20 cm after treatment with aqueous solutions of pH 5.7, 3.5, and 2.0. Sampling was carried out in the laboratory over a 16-d period during which the soil received a total accumulation of 935 mm of simulated rainfall, equivalent to 1 year's precipitation. Highest concentrations of each of total organic carbon, total carbohydrate, and fulvic acid were obtained after the pH 5.7 treatment; the concentrations were greater at the 10-cm depth than at 20 cm. The pH 2.0 solution dissolved the least amounts of these components. The opposite trend was observed in the analyses of ammonium-plus-amino nitrogen. The soil exhibited considerable buffering action in terms of regulating leachate pH. (Author's abstract)
W86-01421

UPTAKE AND RELEASE OF SOME TRACE METALS BY AQUATIC BRYOPHYTES IN ACIDIFIED WATERS IN SCOTLAND,
Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 7B.
W86-01452

EFFECTS OF AUTUMN APPLICATION OF OIL ON SPARTINA ALTERNIFLORA IN A TEXAS SALT MARSH,
Texas A and M Univ. at Galveston. Dept. of Marine Biology.
J. W. Webb, S. K. Alexander, and J. K. Winters.
Environmental Pollution (Series A), Vol. 38, No. 4, p 321-337, 1985. 1 Fig, 5 Tab, 35 Ref. State of Texas grant 18837.

Descriptors: *Water pollution effects, *Oil pollution, *Spartina, *Salt marches, *Texas, Marshes, Sediments, Aquatic plants, Plant growth, Biodegradation, Biomass.

Arabian crude oil, Libyan crude oil, No. 6 fuel oil and No. 2 fuel oil were applied, in November 1981, to 1 sq m salt marsh plots in Galveston Bay, Texas. Oil treatments were: no oil, 1 liter on sediment, 1.5 liters on sediment and lower 30 cm of Spartina alterniflora and 2 liters on sediment and entire S. alterniflora surfaces. All oils caused death of above-ground parts of plants within 3 weeks when applied to entire plant surfaces. Partial coverage was harmful only with No. 2 fuel oil, while sediment application had no effect. By 5 months, new growth had occurred from roots and rhizomes in Arabian crude oil, Libyan crude oil and No. 6 fuel oil plots and live biomass was near that of controls. By 1 year recovery was complete. For No. 2 fuel oil plots, which sustained the greatest mortality, growth was significantly below control levels at 5 months and 1 year, but recovery was complete within 2 years. Slow recovery in No. 2 fuel oil plots appeared to be due to the initial mortality of below-ground, as well as above-ground, plant parts. Toxicity of residual oil in the sediment did not appear to be a factor in slow recovery since seedling establishment had occurred within 5 months and little residue of No. 2 fuel oil was present in the sediments after 1 year. Also, this residue did not contain alkyl-substituted naphthalenes, toxic components present in the original oil. Considerable residues of all oils except No. 2 fuel oil were present in the sediment after 1 year. Pristane/nC17 and phytane/nC18 ratios indicated that removal of some oil components had occurred through biodegradation. (Author's abstract)
W86-01465

IMPACT OF LAND-APPLIED INCINERATOR ASH RESIDUE ON A FRESHWATER WETLAND PLANT COMMUNITY,
Massachusetts Univ., Waltham. Suburban Experiment Station.

J. S. Mika, K. A. Frost, W. A. Feder, and C. J. Puccia.
Environmental Pollution (Series A), Vol. 38, No. 4, p 339-360. 1985. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Ash, *Land disposal, *Wetlands, *Vegetation, Species abundance, Species diversity, Environmental effects, Phytotoxicity, Groundwater pollution, Landfills.

In 1977, 60-70 tons of incinerator ash residue were deposited adjacent to a freshwater wetland. These residues are known to contain elevated concentrations of soluble cations and toxic elements. The impact on the wetland plant community was monitored over a 6-year period. Changes in species abundance and diversity were assessed both over time and distance from the residue deposition. A methodology from the marine benthic pollution literature as used to identify possible indicator species from the group of moderately adapted plants. Distance from the residue did not account for the overall increase in community richness, but appeared to be a factor in the increased relative abundance of moderately adapted species near the residue site, as a result of decreased relative abundance of dominant species. Acute phytotoxic effects were undetected, with the possible exception of the decline of Asclepia syriaca (milkweed). Post-experiment soil analyses indicated an increase of Ca, Mn, P, Zn and Cd in wetlands soils near the residue site and an even greater increase in P, K, Ca, Mg, B, Zn, Cu, Mn, Al, Cd, and Pb in the soil directly beneath the residue. If residue landfills are not properly designed or maintained, the cumulative impact of daily residue deposition could eventually disrupt sensitive ecosystems and pollute adjacent soils and groundwater. (Author's abstract)
W86-01466

WATERBORNE EPIDEMIC OF ACUTE INFECTIOUS NON-BACTERIAL GASTROENTERITIS IN ALBERTA, CANADA,
903 Abbotsford Drive N.E., Calgary, Alberta T2A 5Y3.
A. E. O'Neil, D. Richen, and P. Lundrie.
Canadian Journal of Public Health, Vol. 76, p 199-203, June, 1985. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Epidemiology, *Public health, *Drinking water, *Gastroenteritis, *Alberta, Water treatment, Monitoring, Wastewater pollution, Water pollution effects, Water quality control.

In February 1983, an epidemic of gastroenteritis affecting approximately 3000 persons occurred in a city of 6500 in Alberta. The onset of 78% of the cases was within a four day period. Vomiting was a sympton in 52% of the cases and diarrhea in 60%. Duration of illness was 24 to 48 hours. Median incubation period was 38 hours. Stool cultures form affected persons were negative for bacterial pathogens. Search for a viral agent has so far been unrevealing. Illness was associated with consumption of water from the municipal system. The execution and monitoring of water treatment were faulty. The source of water in that system is a river whose pollution was augmented just before the epidemic by a discharge of raw sewage from a lift station of the municipal sewage collection system. A chain of causation in a gastrointestinal epidemic is illustrated, against which legislation for protection exists in the Clean Water Act. Those carrying out the treatment of the water and the protection of the river and even those charged under the Act with monitoring and enforcing these functions had a weak appreciation of their significance to Public Health. (Author's abstract)
W86-01486

LIMITATIONS OF PHOSPHORUS WATER QUALITY CRITERIA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5G.
W86-01492

EFFECT OF SUSPENDED SOLIDS ON THE GROWTH OF APICAL TIPS OF GAMETOPHYTE PLANTS OF LEMANEA AND ON CARPOSPORE GERMINATION AND SUBSEQUENT COLONISATION,
University Coll., Cardiff (Wales). Dept. of Plant Science.
H. H. Thirb, and K. Benson-Evans.
Archiv fur Hydrobiologia, Vol. 103, No. 4, p 40-417, June, 1985. 3 Tab, 18 Ref.

Descriptors: *Suspended solids, *Plant growth, Light penetration, Water pollution effects, Plant reproduction.

Lemanea was exposed to a range of concentrations of suspended solids and settled material covering the substrate. Coal dust was used as a source of suspended solids. In addition to the laboratory experiments, a field experiment involving the transplant of mature plants of Lemanea from a site with low suspended solids and little pollution to a site downstream where the suspended solids were high. Reduction in light intensity from turbid conditions of suspended solids (5,000 mg/l) reduced primary production in both the chantransia-stage and adult plants. The deposition of a thick layer of silt prevented fixation and colonization of the substrate by carpospores. (Baker-IVI)
W86-01498

EFFECTS OF A CRUDE OIL SPILL ON WATER QUALITY AND MACROBENTHOS OF A SOUTHEAST TEXAS STREAM,
Lamar Univ., Beaumont, TX. Dept. of Biology.
R. C. Harrel.
Hydrobiologia, Vol. 124, No. 3, p 223-228, May, 1985. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Oil spills, *Water pollution effects, *Stream pollution, *Benthos, *Texas, Water quality, Oil pollution, Dissolved oxygen, Carbon dioxide, Invertebrates, Species diversity, Oligochaetes, Midges, Streamflow, Water temperature.

On December 6, 1981 a crude oil spill of 160 barrels (25,440 liters) occurred in a small southeast Texas stream. On December 8 a boom was placed across the mouth of the stream, and organized cleanup began December 12. During the cleanup, some oil was manually pushed down into the steam sediments. Water quality changes, other than the presence of oil, were not evident until six months later when water temperature increased and stream flow ceased. A thick film of oil and plant detritus covered the surface of the stream. This resulted in decreased dissolved oxygen and increased carbon dioxide concentrations. Responses of the benthic macroinvertebrate community included an increase in density of oligochaetes, decrease in numbers and taxa of chironomids, with eventual complete elimination, and low community diversity. Decrease in oil concentration resulted in reversal of these responses. Eleven months after the spill, stream flow had resumed and water temperature decrease, but oxygen concentrations remained low. No clean water taxa were collected and complete recovery had not occurred 26 months after the spill when the study was terminated. All taxa were tolerant or facultative to organic pollution. (Moore-IVI)
W86-01506

MONITORING AND EVALUATION OF WATER POLLUTION IN TUMEN RIVER BY MEANS OF ALGAE (IN CHINESE),
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
Z. Zhand, Z. Mo, K. Rong, and H. Haoming.
Acta Hydrobiologica Sinica, Vol. 8, No. 1, November, 1983. 2 Fig, 7 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Algae, *Monitoring, *Tumen River, Scenedesmus, Bioassay, Industrial wastewater, Bioindicators, Periphyton, Photosynthesis.

Studies on attached algae communities, collected from artificial substrates, were made in upper and middle reaches of Tumen River in 1977-1979. Bioassay using Scenedesmus for some effluents was carried out in laboratory. Based on results obtained, an evaluation of water pollution in the River was made. The upper reach, represented by station Chongshan, is evaluated as an unpolluted area. The middle reach, from the drainage of iron-ore mining effluents downwards to station Xiangrenping, is a heavily to moderately polluted area. From station Caidui, where the River receives the pulp mill effluent, to city Tumen, the river water is most heavily polluted. The stretch of River between station Hedung and the pollution source of a brown-coal chemical industry in the lower reach is considered as slightly to moderately polluted. Bioassay test also show that pulp mill effluent is one of the main pollution sources of River Tumen. The acute ILm of Scenedesmus to the main sewer effluent of the pulp mill is about 45% (v/v). The most toxic is the sulfite waste liquor. The harmful effect on algae growth by iron-ore mining effluent is caused by the large amount of suspended solids contained in this effluent, which reduces photosynthetic activity of algae. This effluent must be considered as another main pollution source of the river. Discussing and comparing the results of periphyton studies in Tumen River, the authors propose some algological indices for monitoring and evaluating pollution conditions in this river. Among them the total count of attached algae is the most suitable and is expressed as a comparable relative value. Some indicator algae species are presented. The application of diversity indexes is discussed. (Author's abstract)
W86-01512

SPY POND DIAGNOSTIC-FEASIBILITY STUDY: RECOMMENDATIONS FOR RESTORING A LAKE IMPACTED BY URBAN STORMWATER RUNOFF,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
For primary bibliographic entry see Field 2H.
W86-01550

SIX PONDS DIOXIN SURVEY,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
J. J. Jonasch.
Northeastern Environmental Science, Vol. 3, No. 2, p 80-89, 1984. 3 Fig, 9 Tab, 8 Ref.

Descriptors: *Dioxins, *Massachusetts, *Lake Winthrop, *Boons Pond, *North Pond, *Nonesuch Pond, *Middlesex County, *Flint Pond, *Worcester County, *Stockbridge Bowl, *Lake Mahkeenac, *Berkshire County, *Chlorinated hydrocarbons, *Fish tissues, Animal tissues, Bullhead, Herbicides, Water pollution effects, Fate of pollutants.

The objective of this study was to determine through a screening survey whether 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) was present in six Massachusetts water bodies that have histories of treatments with herbicides (Silvex, Kuron, or 2,4,5-T) that contain 2,3,7,8-TCDD as a contaminant formed during the manufacturing process. The water bodies studied were Lake Winthrop, Boons Pond, North Pond, and Nonesuch Pond (Middlesex County), Flint Pond (Worcester County), and Stockbridge Bowl (Lake Mahkeenac) (Berkshire County). Five of the six sediment samples analyzed did not meet the analytic criteria for positive identification of the dioxin. Detection limits ranged from 3.0 ppt to 5.5 ppt. Lake Winthrop did meet the criteria for positive identification and the sediment had a 2,3,7,8-TCDD concentration of 5.9 ppt. The survey confirmed the presence of 2,3,7,8-TCDD in one pond with a sediment sample containing 5.9 ppt 2,3,7,8-TCDD and a fish sample (bullhead - Ictalurus sp.) containing 71 ppt of 2,3,7,8-TCDD. Age analysis suggests that all fish have had at least 2.5 years of exposure in their respective lakes with a study-wide average of 4.9 years. Lake Winthrop appears to have been treated very little over the years compared to the other lakes studied. The fish flesh concentration exceeds the U.S. Food and Drug Administration guideline of 50 ppt in fish flesh for human consumption. The five archived bullheads from Lake Winthrop were retested and nets were set in the lake to capture more specimens. Yellow perch and pickerel specimens had no detectable levels of 2,3,7,8-TCDD.

Only one of the bullheads had a detectable level of 2,3,7,8-TCDD; in two tests the concentration was determined to be 19 and 25 ppt. The high detection limits in the other samples present a problem since 2,3,7,8-TCDD could possibly be present below these limits. (Collier-IVI)
W86-01551

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PCB PROBLEM: A REVIEW,
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 5B.
W86-01553

HUDSON RIVER PCB RELATIONSHIPS BETWEEN RESIDENT FISH, WATER AND SEDIMENT,
New York State Dept. of Environmental Conservation, Albany.
R. Sloan, M. Brown, and R. Brandt.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 137-151. 18 Fig, 7 Tab, 37 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Fish, *Sediment, *Fate of pollutants, Monitoring, Chlorinated hydrocarbons, Water pollution effects, Pumpkinseed, Fish tissues, Estuarine environment.

In 1977, long term monitoring of PCB levels in several environmental strata in the Hudson River was initiated. Among the variety of fish species that have been monitored, fall-caught yearling pumpkinseed (Lepomis gibbonsus) were selected as a standardized tool for monitoring trends in the PCB contamination of the river's biota. This phase of monitoring was implemented in 1979, two years after cessation of the major PCB discharges at Ft. Edward and Hudson Falls. The high degree of correlation between waterborne and yearling pumpkinseed PCB concentrations demonstrated through time for a region of the upper Hudson that yearling pumpkinseed are a sensitive indicator of PCB environmental contamination. A decline in PCB concentrations in both water and fish was evident throughout the river through 1980. An 80-year flood during spring 1983 apparently did not increase the availability of PCB to the biota in the upper river. In the lower river, the bioavailability of PCB appeared to increase in the Newburgh area as indicated by an increase in the mean PCB concentration in the yearling pumpkinseed. The mean PCB concentration in pumpkinseed collected at Albany and Stillwater did not change significantly. These observations are consistent with a working hypothesis of how the hydrology and transport regimes of the upper and lower river mediate the environmental exposure of the biota to PCB. Comparisons among other adult spring sampled species and older age classes of the pumpkinseed through 1983 show that although increases were not uniform neither was there evidence of continued decline. Coupled with relatively high sediment concentrations, it appears that this system has reached a quasi-stable state with respect to PCB levels in the biota. (Author's abstract)
W86-01554

PCBS: DIETARY DOSE AND BURDENS IN STRIPED BASS FROM THE HUDSON RIVER,
New York Univ. Medical Center, Tuxedo Park. Lab. of Environmental Studies.
J. M. O'Connor.
Northeastern Environmental Science, Vol. 3, No 3/4, p 152-158. 4 Tab, 30 Ref. NIEHS grant ES00260.

Descriptors: *Polychlorinated biphenyls, *Bass, *Fish tissues, *Hudson River, *New York, *Water pollution effects, Fish diets, Chlorinated hydrocarbons, Gammarus, Amphipods.

Data supporting the hypothesis that polychlorinated biphenyl (PCB) body burdens in fish are related to the daily dietary dose, as modified by the metabolic processes of assimilation, tissue retention and elimination have been based exclusively on laboratory studies. As a field verification of this hypothesis samples of striped bass, and their stomach contents, were analyzed for PCBs in order to determine relationships between PCB concentration in the food and PCB burdens in the fish. Samples of striped bass were collected from the New York Harbor region (the Hudson River at Weehawken, NJ (WHK) and between piers at Canal Street in Manhattan, NY (CST)) during the winter of 1983. The majority of food organisms observed in striped bass stomachs were benthic and epibenthic crustacea, primarily Gammaridean amphipods. Total body burden of PCB in young striped bass was calculated as the concentration of PCB in the flesh times the dry-weight of the specimen with the dry-weight concentration in the flesh assumed to be the same as the dry-weight concentration in most of the tissues and organs. Due to the greater concentration of PCB in striped bass from CST, PCB burdens (mean = 67.6 micro-g total PCB) were greater than in the bass from WHK (mean = 25.7 micro-g). Stomach contents from striped bass taken at WHK contained a mean of 2.3 micro-g/g total PCB, while the PCB concentrations of stomach contents from fish taken at CST were 6.15 micro-g/g. At the CST station, PCB concentrations in the food were greater than in the flesh of the fish. At the WHK station the PCB concentrations in the food and in the fish were similar. The ratio of mean PCB concentrations in stomach contents to that of the flesh was similar at the two stations (0.70 at WHK and 0.71 at CST). The results provide paired dose/burden data useful in refining mathematical models for predicting the accumulation of PCB and other xenobiotics in fish, based upon empirical data rather than rough estimates of exposure parameters. (Collier-IVI)
W86-01555

ORIGIN OF HIGH CADMIUM CONCENTRATIONS IN HUDSON RIVER BLUE CRAB (CALLINECTES SAPIDUS RATHBUN),
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
R. Sloan, and R. Karcher.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 221-231. 4 Fig, 4 Tab, 37 Ref.

Descriptors: *Cadmium, *Animal tissues, *Crab, *New York, *Hudson River, *Flushing Bay, *Long Island Sound, Heavy metals, Metals, Water pollution effects, Source of pollutants, Mercury, Public health.

In 1979, due to high cadmium concentrations in blue crab, Callinectes sapidus, the New York State Health Department warned against consuming the hepatopancreas and to restrict leg meat consumption to one meal per week, based on a limited Hudson River summer sampling. A lack of data from other localities led to collections in 1981 from 11 locations in New York marine waters, including 6 Hudson river, 1 Staten Island and 4 Long Island sites. Muscle and hepatopancreas tissues were analyzed for cadmium utilizing atomic absorption spectrophotometric techniques. Although female sample sizes were small in areas of high contamination, they tended to have greater cadmium concentrations than males by factors of 1.5 to 2. Regardless of sex, the six Hudson River locations produced average concentrations of 0.24 ppm (N = 55) and 7.86 ppm (N = 60) for the leg muscle and hepatopancreas, respectively, compared to average values for similar tissues from other areas (excluding Flushing Bay) of 0.09 ppm (N = 25) and 0.72 ppm (N = 25). Cadmium concentrations were two to five times higher in thoracic muscle than leg muscle (N = 8). Flushing Bay crabs had higher hepatopancreas levels (-x = 3.84 ppm; N = 8) than other Long Island crabs indicating a potential cadmium source. Overall, the bulk of cadmium contamination appears to originate in the Hudson River. Limited numbers of mercury analyses reflected relatively low concentrations with respect to the USFDA action level of 1 ppm. Lobsters (Homarus americanus) from western Long Island Sound were suprisingly high in cadmium, and the few analyzed (N = 10) indicate a need for additional study of this species. (Author's abstract)
W86-01565

SURVIVAL STRATEGIES OF INVERTEBRATES IN DISTURBED AQUATIC HABITATS,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-01581

RESPONSE OF INVERTEBRATES IN TEMPORARY VERNAL WETLANDS TO ALTOSID SR-10 AS USED IN MOSQUITO ABATEMENT PROGRAMS,
Minnesota Dept. of Natural Resources, St. Paul.
R. W. Lawrenz.
Journal of the Minnesota Academy of Science, Vol. 50, No. 3, p 31-34, 1984/85. 2 Fig, 5 Ref.

Descriptors: *Mosquitos, *Invertebrates, *Wetlands, *Insecticides, *Ecological effects, Water pollution effects, Pesticides, Toxicity, Hormones.

Three temporary vernal wetlands on the Bayport Wildlife Management Area in eastern Washington County, Minnesota, were divided by sandbag barrier into treatment and control areas. Designated areas were treated with Altosid SR-10 briquets at standard mosquito control rates. Invertebrate populations were monitored weekly using net sweeps, column samples, and ocular estimates. The development of Eubranchipus bundyi, Lyncerus sp, and Daphnia sp., the three major components of the invertebrate fauna, was delayed by as much as one week in site 47. Similar development lags were noted for E. bundyi populations in the treated portions of sites 6 and 32. Delay of maturation was expressed in greater longevity and higher male to female sex ratios for treated populations of E. bundyi. Daphnia sp. population growth was also retarded by treatment, with a concurrent lag in ephippium (resting egg) formation. Delay in the development or sexual maturity of vernal faunas could impact those faunas and the wildlife that are dependent on them as seasonal dietary protein resources. (Author's abstract)
W86-01582

IDENTIFYING POLLUTION RELATED CHANGES IN CHIRONOMID COMMUNITIES AS A FUNCTION OF TAXONOMIC RANK,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. C. Waterhouse, and M. P. Farrell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 406-413, March, 1985. 2 Fig, 3 Tab, 21 Ref. EPA grant R805193-02-2 and DOE contract DE-AC05-840R21400.

Descriptors: *Water pollution effects, *Midges, *Taxonomy, Heavy metals, Metals, Zinc, Copper, Chromium, Invertebrates, Presence/absence data, Ecological effects.

Specific- and generic-level analyses of chironomid presence/absence data were compared along a heavy-metal gradient. Eighteen binary similarity coefficients were calculated for five sampling stations from a small Ohio stream that receives an effluent containing zinc, copper, and chromium from a metal-plating industry. In general, the specific- and generic-level values were highly correlated and showed similar patterns across the 10 station comparisons. The basis for this correlation was then investigated by an assessment of both the amount (average number of species per genus) and the pattern (species to genus ratio trend) of information loss along the pollution gradient. Trends in the species to genus ratio along the gradient are viewed as indicative of the similarity of congenerics in their response to the gradient. The lack of a significant trend in the species to genus ratio in our data indicates that the agreement between specific- and generic-level analyses was due to the ability of a robust species distribution pattern to withstand a limited amount of random information loss, rather than any inherent similarity among congenerics reflected in their species to genus ratio trends. Analyses based on only a few species (e.g. abundant or indicator species) cannot afford as much information loss and must rely more heavily on similarity of congeneric species. (Author's abstract)

W86-01583

DISCRIMINATION OF THE STOCK OF FISH (EELS, ANGUILLA ROSTRATA) BASED ON THE PRESENCE OF THE SYNTHETIC CHEMICAL MIREX (DISCRIMINATION D'UN STOCK DE POISSON, L'ANGUILLE (ANGUILLA ROSTRATA), BASEE SUR LA PRESENCE D'UN PRODUIT CHIMIQUE DE SYNTHESE, LE MIREX),

Department of Fisheries and Oceans, Quebec. Fisheries Research Branch.
J. D. Dutil, B. Legare, and C. Desjardins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 455-458, March, 1985. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Bioindicators, *Fisheries, *Eels, *Saint Lawrence River, *Ontario, *Quebec, *Lake Ontario, *Mirex, Pesticides, Chlorinated hydrocarbons, Path of pollutants, Water pollution effects, Fish, Water quality.

Mirex concentrations were measured in eels (Anguilla rostrata) from eastern Canada to determine the contribution of Lake Ontario eels to the Saint Lawrence commercial fishery. Mirex could be detected in all eels (50 specimens) collected in Lake Ontario (0.18 + or - 0.11 micro-g/g). Most sedentary eels collected from the Saint Lawrence commercial fishery and both the migratory and sedentary eels collected from the Saint Lawrence tributaries and the Maritimes had no mirex. Of the migrating eels collected in the Saint Lawrence 74% contained mirex (0.17 + or - 0.19 micro-g/g). These results show that stocks can be discriminated on the basis of the presence of synthetic chemical products such as pesticides and other contaminants that are distributed heterogeneously in the environment. Based on a presence-absence criterion, this method for stock discrimination has the distinct advantage that it is more accurate and less time consuming than similar methods based on the presence of natural chemical products. (Author's abstract)
W86-01584

WINTER RESPIRATION OF LAKES AT SAQVAQJUAC, N.W.T.,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W86-01587

RESULTS OF OHIO RIVER MACROINVERTEBRATE SAMPLING FOR 1975-1981,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. E. Fisher, and L. E. McCoy.
Proceedings of the West Virginia Academy of Sciences, Vol. 55, No. 2/3/4, p 42-55, 1983. 9 Fig, 7 Ref.

Descriptors: *Ohio River, *Macroinvertebrates, *Species diversity, *Rivers, Water pollution effects, Species composition.

The results of macroinvertebrate sampling from nine stations along the Ohio River are presented. Comparisons of Brillouin diversity, numbers of individuals, and taxa present for each site indicated significant improvements in the biological communities for two sites, Weirton and Hannibal. Only one site, Keyger Creek, was significantly poorer over time. Most other stations appeared to have made some improvement or remained unchanged, with the notable exceptions, however, of Willow Island and Belleville. These stations appeared to have been adversely impacted by some factor or combination of factors. The Belleville site had shown continued improvement from 1975 through 1980. However, the 1981 sample revealed a significant drop in diversity. (Author's abstract)
W86-01591

ASSOCIATIONS OF CANCER MORTALITY RATES AND EXOGENOUS ENVIRONMENTAL FACTORS IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Anatomy.
P. Baciu, E. C. Keller, and J. D. Tucker.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 82-91, 1983. 4 Tab, 6 Ref.

Descriptors: *Cancer, *West Virginia, *Water pollution effects, *Public health, Epidemiology, Alkalinity, Acidity, Zinc, Dissolved oxygen, Phosphate, Manganese, Water quality.

Correlation analyses were completed on West Virginia county data for cancer mortality rates and on county geological, water quality, and coal production variables. The individual cancer mortality variables most frequently observed to be in association with environmental variables were: mouth, pancreas, and rectal cancers in males, and nasal, lip, and stomach cancers in females. The environmental variables most frequently associated with these cancer were: (1) levels of alkalinity, water flow, acidity, zinc, dissolved oxygen, phosphate, and manganese found in the natural waters of the various counties; (2) levels of particulates, hydrocarbons, and nitrous oxides in the air; (3) the percentage of the county underlain by brine, medium bituminous coals, and three types of limestones; and (4) to a minor degree, the number of sand quarries in the county. An 'acid mine drainage' environmental factor as defined by factor analysis was highly associated with two cancer mortality groupings viz., 'male digestive' and 'female upper digestive' cancers. Two other water factors 'alkalinity' and 'zinc' were also strongly associated with the 'male digestive' cancer factor. The environmental factors are likely to be, at least in part, surrogates for other populational or occupational aspects of the demography such as urban-industrialized and rural-coal-producing areas. (Author's abstract)
W86-01593

CORBICULA FLUMINEA (MOLLUSCA: PELECYPODA) AS A BIOLOGICAL INDICATOR OF HEAVY METALS IN THE KANAWHA RIVER, WV,

Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
For primary bibliographic entry see Field 7A.
W86-01596

LOW PH TOLERANCE UNDER CONTINUOUS-FLOW BIOASSAY CONDITIONS OF HELLGRAMMITE LARVAE, CORYDALUS CORNUTUS L. (MEGALOPTERA: CORYDALIDAE),

Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
D. C. Tarter, L. O. Hartsock, S. I. McBride, and M. F. Sheridan.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 131-135, 1983. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Acidity, *Hydrogen ion concentration, *Toxicity, *Helgrammites, *Corydalidae, *Macroinvertebrates, *Bioassays, Water pollution effects, Acid mine drainage, Aquatic insects, Larvae.

Bituminous coal mining produces an acid drainage effluent that is generally recognized as the most widespread pollution problem in the Ohio River Basin. Hellgrammite larvae, Corydalus cornutus L., were experimentally tested under continuous-flow bioassay conditions to determine their tolerance to low pH. The straight-line graphical interpolation method was employed to determine the pH value at which 50 percent of the hellgrammites survived after 96 hours. The 96 hr median tolerance limit pH value was 1.76. Based on the hellgrammite larval continous-flow bioassay experiments and other laboratory and field studies of aquatic insects, the order Megaloptera can be considered the group of aquatic insects most tolerant to low pH conditions. The toxic mode of action of acid mine drainage on benthic macroinvertebrates has received some attention in the literature. Several mechanisms may be involved in the toxic mode of action of acid mine water on aquatic insect larvae. Apparently, larval megaloptera ns are able to survive in higher concentrations of acid mine drainage than most aquatic insects because of some well-adapted physiological response to these extreme environmental conditions. (Collier-IVI)
W86-01597

EFFECT OF TEMPERATURE ON THE GROWTH OF PLANKTONIC LARVAE OF TELLINA TENUIS DA COSTA,

Dunstaffnage Marine Research Lab., Oban (Scotland).
P. R. O. Barnet.
Journal of Experimental Marine Biology and Ecology, Vol. 89, No. 1, p 1-10, June, 1985. 4 Fig, 36 Ref.

Descriptors: *Kames Bay, *Firth of Clyde, *Scotland, *Tellina, *Bivalves, *Water temperature, *Growth rates, Water pollution effects, Growth stages, Molluscks.

Tellina tenuis da Costa has wide distribution on the intertidal sandy shores of Europe and is the commonest intertidal lamellibranch on most clean sandy shores in the Firth of Clyde, Scotland, where large annual variations in spatfalls are known to occur. The effects of temperature on Tellina populations in Kames Bay were examined, continuing earlier research, for comparison with the influences of heated effluents from the Hunterston electricity generating stations at Ayrshire. The growth in length of planktonic veliger larvae was examined experimentally at 7, 10, 15, and 20 C. There were very pronounced differences between the lengths at different temperatures. The experiments commenced four days after fertilization with straight-hinge larvae of mean length 104 micro-m. Three days later t-tests showed that there were highly significant differences between the mean lengths of larvae grown at 7, 10, 15, and 20 degrees C (104, 107, 111, 115 micro-m, respectively). There were large differences between the lengths at the end of the experiment, 32 days after fertilization; 20 C larvae reached a mean of 216 micro-m compared with 196 micro-m at 15 C, 142 micro-m at 10 C, and only 117 micro-m at 7 C. The greatest increase in growth rate was between 10 and 15 C; this is the range within which July sea-water temperatures, when large numbers of larvae are expected to be in the plankton, vary between warm and cool years. Sea-water temperatures in the Firth of Clyde probably never reach a level permitting optimum growth; higher July sea-water temperatures in some years may encourage more rapid larval growth than in cooler years. This would shorten the pelagic larval phase, probably decreasing the vulnerability to predation in the plankton and permitting better survival to the settlement phase and may partly account for the large annual variability in spatfalls of T. tenuis in Kames Bay. (Collier-IVI)
W86-01603

BENTHIC ORGANISMS AS INDICATORS OF WATER QUALITY IN LAKE PATZCUARO, MEXICO,

Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
For primary bibliographic entry see Field 5A.
W86-01608

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - I; REVIEW OF PREVIOUS RESEARCH,

Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 947-954, 1985. 9 Tab, 22 Ref.

Descriptors: *Pulp wastes, *Wastewater pollution, *Microorganisms, *Reviews, Pulp and paper industry, Water pollution effects, Biological wastewater treatment, Sugars, Fatty acids, Alcohols.

The term 'sewage fungus' denotes the variable community of microorganisms which form voluminous, cottonwool-like growths on river beds having suitable physical characteristics. A brief review is given of the published literature on sewage fungus growth from pulp and paper mill discharges up to 1978. Previously unpublished work undertaken over the period 1965-1975 is described. By 1978, it seemed clear that sewage growth from pulp and paper industry effluents was caused by the presence of low molecular weight organics, a mixture of sugars, volatile fatty acids and alcohols in the case of pulping wastewaters and starch-derived sugars in paper/board mill wastewaters. Intermittent discharge was a proven technique for controlling sewage fungus growth from pulp mill effluents. While biological treatment of papermill discharges could achieve high BOD removal, the inherent variability in the performance of biological plants precluded the complete elimination of sewage fungus growth potential when the dilution available was only of the order of 10- to 20-fold. (Moore-IVI)
W86-01635

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - II; CHEMICAL ANALYSIS OF MILL EFFLUENTS,
Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 955-959, 1985. 4 Tab, 3 Ref.

Descriptors: *Pulp wastes, *Effluents, *Chemical composition, *Wastewater pollution, Dissolved solids, Organic matter, Carbohydrates, Glucose, Gelatin, Melamine, Sugars, Nutrients.

A sampling and analytical program was carried out at three U.K. paper and board mills, the objective of which was to characterize the dissolved organic matter in final effluents and component wastewater streams. The analyses conducted were dissolved organic carbon (DOC), carbohydrate, glucose, gelatin, melamine, hydrolyzed sugars and molecular weight distribution. For 2 mills using virgin wood pulp and waste-paper, carbohydrates (principally glucans) are the major dissolved organic component (70-80% DOC). The concentrations of low molecular weight oligosaccharides and glucose at both mills could be very significant in terms of sewage fungus growth in the receiving river, depending on the dilution available. At a third mill with on-site chemical pulping of rags, carbohydrate was less dominant in the mixed effluent, which contained a high proportion (70%) of thus far unidentified organics. While the likely nutrients for sewage fungus growth at the third mill are thus less definite, the identified organics (carbohydrate plus gelatin) are more degraded than the organics at other mills. This factor combined with the low effluent dilution available may compensate for the lower nutrient concentrations. (Moore-IVI)
W86-01636

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - IV; GROWTH IN EXPERIMENTAL CHANNELS DOSED WITH EFFLUENTS AND PURE COMPOUNDS,
Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 969-974, 1985. 2 Tab, 6 Ref.

Descriptors: *Wastewater pollution, *Pulp and paper industry, *Microorganisms, Water pollution effects, Pulp wastes, Carbohydrates, Effluents, Nutrients, Glucose, Starch, Gelatin, Resins, Organic compounds.

This is the fourth and final paper in a series of articles describing research undertaken at PIRA during 1978-1980 on the causes and prevention of sewage fungus growth in rivers receiving paper and board mill effluents. This paper describes simulated stream studies in which sewage fungus growths from mixed mill effluents, component effluent streams and mill raw materials were quantified at two paper-mill sites. At the first mill, sewage fungus growth from treated effluent was only light and somewhat less than might have been expected from the measured level of glucose. Cationic starch was a better nutrient than unmodified starch and possible reasons for this are put forward. Individual waste streams at the second mill supported heavy growths of sewage fungus comparable to that from the mixed mill effluent after clarification. As sole sources of organic carbon, fresh or degraded gelatin and melamine formaldehyde resin gave very little sewage fungus growth, but glycerol supported some growth. As the effluent from this mill was considerably more complex than others previously examined, it was concluded that sewage fungus nutrients were provided by degraded organics (largely unidentified) extracted from rags and broke. (Author's abstract)
W86-01638

EVALUATION OF MATHEMATICAL MODELS FOR THE EFFECTS OF PH AND TEMPERATURE ON AMMONIA TOXICITY TO AQUATIC ORGANISMS,
College of Saint Scholastica, Duluth, MN. Dept. of Chemistry.
R. J. Erickson.
Water Research, Vol. 19, No. 8, p 1047-1058, 1985. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Mathematical models, *Hydrogen ion concentration, *Temperature, *Ammonia, *Toxicity, Aquatic animals, Gills, Fish.

Available data on the pH and temperature dependence of ammonia toxicity to aquatic organisms were examined and their agreement with various models was evaluated. A model which considers alteration of the relative concentration of un-ionized ammonia at the gill surface failed to adequately describe either pH or temperature dependence. A model that assumes that un-ionized ammonia and ammonium ion are jointly toxic was strongly supported by the data on pH dependence, but could not explain observed temperature dependence. Temperature dependence can be described empirically by a simple log-linear model. The effects of pH and temperature were generally found to be qualitatively and quantitatively similar among fish species. (Author's abstract)
W86-01648

ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN SEDIMENT AND FISH FROM WETLANDS IN THE NORTH CENTRAL UNITED STATES,
Columbia National Fisheries Research Lab., Yankton, SD. Field Research Station.
D. B. Martin, and W. A. Hartman.
Journal of the Association of Official Analytical Chemists, Vol. 68, No. 4, p 712-717, July/August, 1985. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Pesticides, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Wetlands, *Sediment contamination, *Fish, Pesticide residues, DDD, DDT, Dieldrin, BHC, Trans-nonachlor, DDE.

Sediments samples collected in 1980-1982 from riverine and pothole wetlands at 17 locations in the north central United States were analyzed for organochlorine pesticides, certain of their metabolites, and polychlorinated biphenyls (PCBs). Concentrations were above minimum detection levels (5 ng/g of organochlorines and 20 ng/g of PCBs) in less than 4% of the samples taken. Fish samples taken at 9 of these 17 locations, and analyzed for the same compounds, showed a higher frequency of detectable contaminants. The most common compound found in fish was DDE, which was found in 51% of the samples at levels up to 512 ng/g. Alpha-BHC was present at concentrations of 5 to 27 ng/g in 36% of the fish samples, and DDD was found at levels of 5 to 60 ng/g in 14%. Four other compounds, DDT dieldrin, PCB, and trans-nonachlor, were detected in fish at relatively low concentrations in less than 10% of the samples. This survey, thus, indicated little contamination by organochlorine pesticides or PCBs in the wetland habitats of this region. (Author's abstract)
W86-01651

ALUMINUM MOBILIZATION IN AN ACIDIC HEADWATER STREAM: TEMPORAL VARIATION AND MINERAL DISSOLUTION DISEQUILIBRIA,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
R. P. Hooper, and C. A. Shoemaker.
Science, Vol. 229, No. 4712, p 463-465, August, 1985. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Aluminum, *Water pollution effects, *Acid rain, *Acidity, *Streams, *Hubbard Brook Experimental Forest, *New Hampshire, Geochemistry, Metals, Hydrogen ion concentration, Seasonal variation, Snowmelt.

As part of an integrated field and modeling study an extensive sampling effort was undertaken on an instrumented watershed at the Hubbard Brook Experimental Forest (New Hampshire) to examine the chemical response of a stream to snowmelt and storm events during the spring of 1984. Intensive sampling was performed along an elevational gradient in the headwater stream to observe the chemical response of the stream to acidic inputs. Aluminum concentrations during this period were not in equilibrium with a readily formed mineral phase, as has been assumed, and the increase in aluminum concentration due to episodic depressions in pH lessened during the snowmelt. The temporal variation in the aluminum response to pH depressions indicates a more complicated aluminum mobilization mechanism than a mineral dissolution equilibrium. This temporal variation may be caused by the depletion of a slowly forming, labile pool of aluminum in the soil. The high aluminum concentrations may be influenced by a kinetic constraint in the precipitation of an aluminum mineral. Since the sampling focused on high flow events, the higher aluminum concentrations at the higher pH's found downstream could have been due to transport of aluminum that did not have time to precipitate out of solution. The observed disequilibrium between aluminum concentrations in stream water and a readily formed Al(OH)3 mineral phase reduce confidence in predictions of short-term temporal changes in stream chemistry made by investigators using models based on an equilibrium. The temporal pattern of the snowmelt is important in the mobilization of aluminum. The highest aluminum concentrations were observed in the midwinter thaw, not during the main spring melt. Because sensitive life stages of fish species are present only at certain times of the year, such patterns are important in the assessment of the biological impacts of acid precipitation. (Collier-IVI)
W86-01678

BEHAVIORAL MODIFICATION OF ESTUARINE FISH EXPOSED TO SULFUR DIOXIDE,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, D. T. Burton, W. C. Graves, and S. L. Margrey.
Journal of Toxicology and Environmental Health, Vol. 13, No 4-6, p 969-978, 1984. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Animal behavior, *Sulfur dioxide, *Fish behavior, *Water pollution effects, *Sulfites, Bass, Menhaden, Water temperature, Avoidance response, Model studies.

This study was designed to determine the avoidance responses of juvenile striped bass (Morone saxatilis) and Atlantic menhaden (Brevoortia tyrannus) exposed to sulfur dioxide (sulfite) at acclimation temperatures of 15, 20, 25, and 30 C. Predictive models were developed and compared for each species at each acclimation temperature. Striped bass avoided 2.2, 2.3, 3.0, and 3.5 mg sulfite/l at 15, 20, 25, and 30 C, respectively. Atlantic menhaden avoided 3.2, 3.6, 2.9, and 3.0 mg sulfite/l at acclimation temperatures of 15, 20, 25, and 30 C, respectively. Acclimation tempera-

ture was an important factor influencing the avoidance response of each species exposed to sulfur dioxide. Striped bass avoided lower concentrations of sulfite than Atlantic menhaden at 15 and 20 C. Both species avoided approximately the same concentration of sulfite at 25 C. Atlantic menhaden avoided lower concentrations of sulfur dioxide than striped bass at 30 C. (Author's abstract)
W86-01679

EFFECT OF SEWAGE SLUDGE ON MICROBIAL ACTIVITY IN AN OLD, ABANDONED MINESOIL,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W86-01702

BIOGEOCHEMISTRY OF LEAD IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-01703

LEAD DISTRIBUTION AND FLUXES IN A HIGH-ELEVATION FOREST IN NORTHERN VERMONT,
Pennsylvania Univ., Philadelphia.
For primary bibliographic entry see Field 5B.
W86-01706

EFFECTS OF PO RIVER INDUCED EUTROPHICATION ON THE DISTRIBUTION AND COMMUNITY STRUCTURE OF CILIATED PROTOZOAN AND MICROMETAZOAN POPULATIONS IN THE NORTHERN ADRIATIC SEA,
Institut Rudjer Boskovic, Rovinj (Yugoslavia). Centar za Istrazivanje Mora.
N. Revelante, M. Gilmartin, and N. Smodlaka.
Journal of Plankton Research, Vol. 7, No. 4, p 461-471, 1985. 2 Fig, 4 Tab, 22 NSF grant F7FO22Y and Smithsonian Institution grant JF-10-SMI.

Descriptors: *Protozoa, *Invertebrates, *Eutrophication, *Po River, *Adriatic Sea, Water pollution effects, Zooplankton, Mixing, Stratification, Seasonal variation, Abundance, Distribution.

The ciliated protozoans and micrometazoans in the northern Adriatic were repeatedly sampled and analyzed during summer and winter periods, with emphasis on quantifying the changes in abundance, and community structure, associated with a trophic gradient created by the discharge of the Po River. The community was characterized by major groups, organism abundance and volume, and size class frequency. The microzooplankton biomass increased 2- to 3-fold toward the western side of the Adriatic off the Po delta, during both 'mixed' and 'stratified' seasons, with increases in both the ciliated protozoans and micrometazoan components. At eutrophic sites and under 'stratified ' conditions a marked increase in the relative abundance of ciliated protozoans was observed, with a relative increase in tintinnid contribution to the total ciliated protozoan biomass. Although marked changes in the ciliated protozoan biomass occurred, little change in their size class structure occurred except as influenced by inflowing waters from the central Adriatic. (Author's abstract)
W86-01757

ABUNDANCE OF WEST INDIAN MANATEES (TRICHECHUS MANATUS) AROUND SELECTED FLORIDA POWER PLANTS FOLLOWING WINTER COLD FRONTS, 1982-1983,
Eckerd Coll., St. Petersburg, FL. Dept. of Biology.
J. E. Reynolds, and J. R. Wilcox.
Bulletin of Marine Science, Vol. 36, No. 3, p 413-422, 1985. 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Manatees, *Powerplants, *Water temperature, *Florida, Air temperature, Behavior, Thermal pollution, Abundance.

Seven 1-day aerial surveys were flown during winter, 1982-1983, to assess manatee abundance. The surveys focussed on five Florida Power and Light Company plants: Cape Canaveral (PCC), Riviera (PRV), Port Everglades (PPE), Lauderdale (PFL), and Ft. Myers (PFM). Of the 1,191 manatees sighted during the surveys, 930 were present in the immediate vicinity of the plants. Ten percent of the total animals sighted were calves, with the highest percentage of calves (13.6%) being present at PFM. Maximum counts of manatees for each plant were as follows: PCC, 15; PRV, 98; PPE, 56; PFL, 16; PFM, 85. With the exception of PRV's maximum count, of the 1982-1983 maxima represent the lowest maximum counts for the respective plants in 6 years of surveys. The low counts most likely reflect the mild winter temperatures. With the exception of PFM, there is no indication that any regional manatee populations have declined significantly. Seventeen regressions compared the following variables: intake water temperature at power plants, mean daily air temperature, and number of manatees observed at each plant. Significant correlations were found only for three regressions of water temperature and number of manatees, for one regression of air temperature and number of manatees, and for one regression of all variables. The remaining regressions indicated correlations that were not significant, supporting the contention that winter cold was not of sufficient intensity or duration in 1982-1983 to cause large numbers of manatees to aggregate. (Author's abstract)
W86-01758

INVESTIGATION OF A EUTROPHIC TIDAL BASIN: PART 2 - NUTRIENTS AND ENVIRONMENTAL ASPECTS,
Southern Water Authority, Otterbourne (England). Resources Planning Lab.
H. A. C. Montgomery, P. G. Soulsby, I. C. Hart, and S. L. Wright.
Marine Environmental Research, Vol. 15, p 285-302, 1985. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Eutrophication, *Tidal basins, *Nutrients, Wastewater pollution, Water pollution sources, Sediments, Phosphorus, Nitrogen, Cycling nutrients, Algal growth.

The eutrophication of Langstone Harbour, a large tidal basin, has been studied by statistically designed nutrient surveys. Rates of input of nutrients from the sea, from effluent discharges and from other sources, have been estimated. Sediment/water interactions have been shown to be important in the phosphate budget of the basin, but they are less important in the nitrogen budget. Deductions were made about the relative importance of the various inputs and processes affecting concentrations of nutrients in the water column. It is concluded that ecologically or aesthetically detrimental growths of macroalgae are unlikely to occur in Langstone Harbour in the foreseeable future and that the removal of nutrient inputs, formerly thought to be necessary, will not, in fact, be required. The principles of the experimental design and of interpreting the data are of general applicability to tidal waters where the ratio of natural to man-made inputs needs to be known, where eutrophication is, or is expected to become, a problem, or where the progressive accumulation of nutrients by recycling is suspected. (Author's abstract)
W86-01789

COMBINED EFFECTS OF SALINITY AND CADMIUM CHLORIDE UPON EMBRYOS AND LARVAE OF THE JAPANESE OYSTER, CRASSOSTREA GIGAS,
Institut Francais de Recherche pour l'Exploitation de la Mer, Arcachon.
R. Robert, and E. His.
Marine Environmental Research, Vol. 15, p 303-312, 1985. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Salinity, *Cadmium chloride, *Oysters, *Embryos, *Larvae, Water pollution effects, Heavy metals, Cadmium compounds, Water pollution, Immature growth stages.

Following the observation of high concentrations of cadmium in Gironde estuarine waters, the response of embryos and larvae of the Japanese oyster, Crassostrea gigas to this heavy metal at various salinity regimes was studied for 10 days in the laboratory. The experimental design was a 4 x 4 factorial experiment using concentrations of cadmium of 0.10, 20 and 50 micro-g/liter and salinities of 20, 25, 30 and 35%. Statistical analysis indicated that the salinity changes have important effects on the embryonic development, survival and growth of C. gigas larvae. No deleterious effect of the toxin at all cadmium concentrations and no interaction between cadmium and salinity were found. (Author's abstract)
W86-01790

TRACE METALS IN BIVALVE MOLLUSCS FROM THAILAND,
Environmental Protection Agency, Kowloon (Hong Kong).
D. J. H. Phillips, and K. Muttarasin.
Marine Environmental Research, Vol. 15, p 215-234, 1985. 1 Fig, 8 Tab, 35 Ref.

Descriptors: *Trace metals, *Mollusks, *Thailand, Cadmium, Chromium, Copper, Iron, Lead, Nickel, Mercury, Zinc, Clams, Cockles, Mussels, Oysters, Shellfish, Public health.

Capture fisheries and aquaculture provide a large quantity of bivalve molluscs for human consumption in Thailand each year. The existing information on trace elements in these bivalves is fragmentary and contradictory. This paper reports data for eight metals (cadmium, chromium, copper, iron, lead, nickel, mercury and zinc) in the four major species marketed. These are the clam Paphia undulata, the cockle Anadara granosa, the green mussel Perna viridis and the rock oyster Crassostrea commercialis. The bivalves analyzed were taken at markets or in the field to cover as many of the major sources as possible. The results indicate no major threat to public health from trace elements in these species from Thailand and lend confidence to the expansion of aquaculture operations. In particular, the levels of lead found in the samples analyzed are considerably lower than those previously reported by other authors. (Author's abstract)
W86-01791

EFFECTS OF OIL AND A DISPERSANT ON INTERTIDAL ORGANISMS IN FIELD EXPERIMENTS WITH A MESOCOSM, THE BREMERHAVEN CAISSON,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
H. Farke, K. Wonneberger, W. Gunkel, and G. Dahlmann.
Marine Environmental Research, Vol. 15, p 97-114, 1985. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Oil pollution, *Dispersants, *Intertidal areas, *Benthos, Water pollution effects, Bacteria, Sediments, Hydrocarbons, Benthic fauna, Benthic flora, Mesocosms.

Three medium-scale field experiments on the effects of oil, a dispersant and an oil/dispersant mixture were carried out in an intertidal mud flat ecosystem of the Wadden Sea (German Bight). For six successive tides each contaminant was added to the water enclosed in a mesocosm during submersion of the flat. The fate of the oil in the sediment and effects on phytobenthos, bacteria and macrozoobenthos were studied. Penetration of the oil into the sediment was mainly observed at the surface layer. Higher oil concentrations and lower boiling polycyclic hydrocarbons were persent when oil was chemically dispersed. Sublethal effects were found in some macrofauna species (reduced feeding activity) and in phytobenthic organisms (increased activity); oil degrading bacteria increased. No major effects were observed when the dispersant alone was added. (Author's abstract)
W86-01792

COPPER AND SILVER ACCUMULATION IN TRANSPLANTED AND RESIDENT CLAMS (MACOMA BALTHICA) IN SOUTH SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W86-01793

TOLERANCE OF BATHYPOREIA PILOSA LINDSTROM (AMPHIPODA: HAUSTORIIDAE) TO ORGANIC AND INORGANIC SALTS OF MERCURY,
Centre de Recherches Marines, Jounieh (Lebanon).
N. H. Khayrallah.
Marine Environmental Research, Vol. 15, p 137-151, 1985. 6 Tab, 52 Ref.

Descriptors: *Mercury compounds, *Amphipods, *Toxicity, Salinity, Temperature, Age, Heavy metals, Organic compounds, Bioaccumulation, Mercuric chloride, Ethyl mercuric chloride.

Toxicity tests of mercuric chloride and ethyl mercuric chloride were run on Bathyporeia pilosa. One-hundred-and-eight factorial combinations were analyzed for each mercurial compound (three salinities, three temperatures, two age groups and six mercury concentrations). These were complemented by an investigation on the uptake and concentration potential of these two compounds by B. pilosa. Toxicity of the inorganic and organic mercury was seen to be directly related to both concentration and temperature and inversely related to salinity and age. Sublethal effects were studied and related to the four parameters investigated. Accumulation of the organic mercury compound was almost twice as rapid as that of the inorganic form, although death occurred where animals contained very similar levels of mercury. (Author's abstract)
W86-01794

INFLUENCE OF CYCLIC EXPOSURE ON THE ACCUMULATION OF HEAVY METALS BY MYTILUS EDULIS PLANULATUS (LAMARCK),
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
N. G. Elliott, R. Swain, and D. A. Ritz.
Marine Environmental Research, Vol. 15, p 17-30, 1985. 8 Fig, 6 Ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mussels, Cadmium, Copper, Lead, Zinc, Cyclic exposure.

Accumulation of cadmium, copper, lead and zinc in the tissues of Mytilus edulis planulatus was examined under cyclic conditions of exposure in order to establish whether the rate of accumulation of the metal is proportional to the time exposed to the elevated concentrations. When exposed to a single metal, the accumulation of lead and zinc was directly proportional to the exposure time, but that of copper was not. Under simultaneous exposure to all four metals both lead and cadmium were accumulated in direct proportion to the exposure time, while copper and zinc were not. Accumulation of the three metals cadmium, copper and zinc was influenced by the presence of other metals. (Author's abstract)
W86-01796

EFFECTS OF DREDGING AND DUMPING ON BENTHOS OF SAINT JOHN HARBOUR, CANADA,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
D. J. Wildish, and M. L. H. Thomas.
Marine Environmental Research, Vol. 15, p 45-57, 1985. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Dredging, *Dumping, *Ecological effects, *Saint John Harbor, *New Brunswick, *Benthos, Water pollution effects, Species composition, Polychaetes.

Of four impoverished communities of benthic macro-infauna in Saint John Harbor, three were attributable to anthropogenic causes: disposal of solid wood wastes, dredging, and dumping activity. Circumstantial evidence indicates that the fourth community resulted from strong tidal currents present in the inner harbor interacting with the sediment causing periodic erosion and deposition, resulting in an impoverished macro-infauna. The dredged area was rapidly recolonized; first by invasive species such as Capitella capitata and Nereis sp. and then by species present in adjacent sediments. The area adversely affected by dumping was of limited extent: of the order of 1 sq km, as indicated by the presence of exotic species in dump soil and the distribution of organic carbon. (Author's abstract)
W86-01798

CHLORINATED HYDROCARBONS AND HATCHING SUCCESS IN BALTIC HERRING SPRING SPAWNERS,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
P. D. Hansen, H. von Westernhagen, and H. Rosenthal.
Marine Environmental Research, Vol. 15, p 59-76, 1985. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Chlorinated hydrocarbons, *Herring, *Fish, *Water pollution effects, *Spawning, *Hatching, Toxicity, Polychlorinated biphenyls, DDD, DDE, Pesticides, Growth stages.

Eggs from 69 females of spring spawning herring from the German Baltic coast (Travemunde, April 1979) were incubated in clean sea water (20 0/00 S, temperature 8 C) under standard conditions. Sixty-one trials could be used for the evaluation of hatching success. Viable hatch was taken as a measure to evaluate the effects of chlorinated hydrocarbons accumulated in gonads, liver and muscle of parental fish. PCB levels in running ripe females ranged on a wet weight basis between 19 and 241 ng/g (gonad), 20 and 377 ng/g (liver) and 11 and 1820 ng/g (muscle). Concentrations of other chlorinated hydrocarbons (DDD, DDE, gamma-HCH, etc.) were in the same range as reported by other authors for Baltic herring. Viable hatch was significantly affected at ovary DDE concentrations higher than 18 ng/g (wet wt) and PCB concentrations of more than 120 ng/g (wet wt). (Author's abstract)
W86-01799

STUDY OF THE TOXICITY OF SOME SILICONE COMPOUNDS IN RELATION TO MARINE BIOLOGICAL CHAINS,
Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
M. Aubert, J. Aubert, H. Augier, and C. Guillemaut.
Chemosphere, Vol. 14, No. 1, p 127-138, 1985. 10 Fig.

Descriptors: *Toxicity, *Silicone compounds, *Marine environment, *Food chains, Organosilicone compounds, Fish, Crustaceans, Mollusks, Bioaccumulation, Phytoplankton, Water pollution effects.

The trophic chain method developed in the laboratory is intended to reconstruct simplified but characteristic ecosystems and thus to provide a predictive method of studying the effects of chemical pollution on the various links in marine trophodynamic chains. The trophodynamic chain method was used in a study of the toxicity of organosilicone compounds and their emulsifier to marine biological chains. The trophodynamic chains studied include a fish benthic chain, a crustacean benthic chain, a mollusk chain and a pelagic chain. The accumulation factors are generally very low (from 0.036 to 2.08). The transfer factor is highest within the pelagic and neritic chains, where the first stage comprises phytoplankton. The silicone compound behaves, at least for a while, as a persistent pollutant, but the transfer and accumulation phenomena are extremely reduced and consequently it does not seem likely that harmful effects will be passed on to the consumer at the end of the chain. (Moore-IVI)
W86-01853

FATE AND TOXICITY OF HIGH DENSITY MISSILE FUELS RJ-5 AND JP-9 IN AQUATIC TEST SYSTEMS,
Georgia State Univ., Atlanta. Dept. of Biology.
J. C. Spain, and C. C. Somerville.
Chemosphere, Vol. 14, No. 2, p 239-248, 1985. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Fate of pollutants, *Fuels, *Water pollution effects, Biodegradation, Path of pollutants, Microorganisms, Shrimp, Sorption, Volatilization, Toxicity, Sediments.

The fate of the fuel components in lab test systems containing water and sediment collected from natural aquatic habitats was measured. Because the high density components seemed to be persistent, the toxicity of the fuels to microorganisms and Mysidopsis bahia were also examined. The difference in density between RJ-5 and JP-9 seems to determine the differences in their fate in aquatic systems. Volatilization of the components from JP-9 is much faster than from RJ-5 because JP-9 floats on the surface of the water. The difference is particularly notable with endo-endo-dihydrodi(norbornadiene) which is present in both fuels; it volatilized from JP-9 mixtues within a few days yet remained for much longer periods in RJ-5. Sorption to the sediment greatly reduced the volatilization of both fuels. The norbornadiene dimers have a higher affinity for sediment than the cyclopentadiene dimers but both types of compounds resisted weathering in the presence of sediment. The structural features of the high density synthetic molecules make them very resistant to microbial attack. Biological transformations of the norbornadiene dimers by the insertion of an oxygen atom were not detected. The fuels were not toxic to microorganisms at low to moderate concentrations but RJ-5 was toxic to mysid shrimp. The recalcitrance of RJ-5 to microbial degradation, affinity for sediment, density, and toxicity to aquatic macrobiota, suggest that a large-scale spill of the fuel could present major environmental problems. JP-9 appears to be much less of a potential problem in the aquatic environment than RJ-5 because of its higher vapor pressure and lower density. (Baker-IVI)
W86-01854

PREDICTING THE EFFECT OF TOXIC SUBSTANCES ON PELAGIC ECOSYSTEMS,
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Fisheries Research Branch.
U. Borgman.
Science of the Total Environment, Vol. 44, p 111-121, 1985. 4 Tab, 20 Ref.

Descriptors: *Ecosystems, *Toxicity, *Prediction, Biomass size spectrum, Lake Ontario, Zooplankton, Phytoplankton, Fish, Body size, Water pollution effects, Growth, Nutrient load.

Recent advances in the description of pelagic ecosystems using the biomass size spectrum can be adapted to predict the effect of toxic substances on whole ecosystems. The method is demonstrated using Lake Ontario as an example. First, the shape of the biomass size spectrum is predicted. Using a previously published estimate of particle-size conversion efficiency (-log(biomass conversion efficiency)/log(predator-prey size ratio)), and an estimated exponent of the allometric relationship between body size and turnover rate of 0.24, the biomass over logarithmically equal size classes in Lake Ontario is estimated to be proportional to body size raised to the exponent-0.02. The biomass within various size classes is then estimated from data on zooplankton and phytoplankton biomass. Total biomass, from algae to fish, is estimated to be 7-16 g/sq m dry weight. The change in biomass and production over various size classes after addition of a toxic substance can then be predicted if the total nutrient load remains relatively constant and if the effect of the substance on biomass conversion efficiency is known. A toxicity sufficient to decrease growth and conversion efficiency by 50% is predicted to reduce production of large fish by 91%, but phytoplankton production by only 12% in the lake. Fish biomass is predicted to drop substantially, phytoplankton biomass should rise,

and zooplankton biomass should remain relatively unaffected. (Author's abstract)
W86-01865

DETOXIFICATION OF COPPER IN THE CELLS OF THE DIGESTIVE GLAND OF MUSSEL: THE ROLE OF LYSOSOMES AND THIONEINS,
Genoa Univ. (Italy). Ist. di Fisiologia Generale.
A. Viarengo, M. N. Moore, M. Pertica, G. Mancinelli, and G. Zanicchi.
Science of the Total Environment, Vol. 44, p 135-145, 1985. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Mussels, *Copper, *Toxicity, Lysosomes, Thioneins, Digestive gland, Heavy metals, Detoxification, Water pollution effects.

The data reported shows that copper is naturally present in the lysosomes and residual bodies of mussel digestive gland, the concentration of the metal being greatly increased for mussels exposed to Cu(2+) (0.04 ppm) for 3 days and then detoxified for 6 days. A procedure has been devised to solubilize the copper that is present in an insoluble form in lysosomes and residual bodies. This procedure disrupts lysosomes with sonication and solubilizes Cu-protein complexes in a hypotonic solution containing 1% 2-mercapto-ethanol and a mixture of antiproteolytic agents. The solubilized copper, representing more than 80% of the total metal present in the organelles, has been found mainly bound to a protein showing characteristics similar to those of metallothioneins: it has a high metal content, a molecular weight of about 12000 as evaluated by gel filtration, a relatively low UV absorbance at 280 nm and a high -SH content, as evaluated by the Shikata orcein cytochemical technique. The lysosomal extracts from the digestive gland of controls contain low basal levels of this copper-rich thionein-like protein which increases 5-6 times when the mussels are exposed to copper (0.04 ppm) for 3 days and then detoxified for 6 days. (Author's abstract)
W86-01866

ACID DEPOSITION AND DRINKING WATER,
Wisconsin Univ.-Madison. Center for Limnology.
M. E. McDonald.
Environmental Science and Technology, Vol. 19, No. 9, p 772-776, 1985. 1 Fig, 1 Tab, 45 Ref.

Descriptors: *Acid rain, *Public health, *Drinking water, Aluminum, Copper, Cadmium, Corrosion, Asbestos, Lead, Groundwater, Surface water, Acid deposition, Water pollution effects.

Acid deposition could affect human health indirectly through two principal routes: bioaccumulation of chemicals in human food and contamination of drinking water. Acid deposition has been shown detrimental to aquatic ecosystems because of increased mobilization of trace metals. Acid deposition may enhance the scavenging of atmospheric contaminants, mobilize natural or synthetic contaminants in catchment areas, and promote corrosion of drinking water distribution systems. Numerous problems are associated with assessing human health risks from drinking contaminated water, such as subchronic effects, latency, antagonism, synergism, and general etiology. One of the most basic deals with the amount of water a person consumes daily. Contaminants of particular concern to human health include mercury, aluminum, copper, cadmium, lead, and asbestos. The source of drinking water is an important factor in determining its potential for being detrimentally affected by acid deposition. The major sources are groundwater and surface water. Other sources include cisterns and water suppliers. Research is needed to provide better estimates of affected populations and of the existing levels of the various contaminants in drinking water to which the affected populations are exposed. (Baker-IVI)
W86-01867

VARIABILITY OF ALUMINUM CONCENTRATIONS IN ORGANS AND WHOLE BODIES OF SMALLMOUTH BASS (MICROPTERUS DOLOMIEUI),
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5A.
W86-01872

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5B.
W86-01873

BIOCONCENTRATION FACTORS OF SOME HALOGENATED ORGANICS FOR RAINBOW TROUT: LIMITATIONS IN THEIR USE FOR PREDICTION OF ENVIRONMENTAL RESIDUES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and A. J. Niimi.
Environmental Science and Technology, Vol. 19, No. 9, p 842-849, 1985. 1 Fig, 7 Tab, 49 Ref.

Descriptors: *Biological magnification, *Trout, *Chlorinated hydrocarbons, *Brominated hydrocarbons, *Fish, Water pollution effects, Partition coefficients, Bioaccumulation, Lake Ontario, Animal tissues.

The bioconcentration factors, BCF's, for 34 chlorinated and brominated chemicals in rainbow trout have been determined by the steady-state approach by using chemical water concentrations in the nanogram per liter range. In addition, for 13 chemicals with a known half-life in trout, BCF's were also estimated by using the kinetic approach. The two methods gave comparable results for compounds with short half-lives in the fish but significantly different results for longer half-life chemicals. The BCF's have been shown to correlate well with octanol/water partition coefficients, Kow, for many of the study compounds. But the BCF's of high molecular weight compounds and compounds metabolized by the fish did not correlate with Kow. The laboratory-derived BCF's were compared to field-derived BCF's for Lake Ontario rainbow trout. This comparison showed that predictions based on laboratory BCF's were useful for chemicals with short half-lives in fish but were much too low for long half-life chemicals, where contaminated food is the major chemical source. (Author's abstract)
W86-01874

GROWTH RESPONSE OF YELLOW-POPLAR (LIRIODENDRON TULIPIFERA L.) SEEDLINGS TO OZONE, SULFUR DIOXIDE, AND SIMULATED ACIDIC PRECIPITATION, ALONE AND IN COMBINATION,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology.
A. H. Chappelka, B. I. Chevone, and T. E. Burk.
Environmental and Experimental Botany, Vol. 25, No. 3, p 233-244, 1985. 2 Fig, 4 Tab, 39 Ref.

Descriptors: *Poplar trees, *Acid rain, *Water pollution effects, *Ozone, *Sulfur dioxide, Plant growth, Air pollution, Trees.

Nine-week-old, half-sib, yellow-poplar were exposed to O3 and/or SO2 (controls, 0.10 ppm O3, 0.08 ppm SO2 or 0.10 ppm O3 + 0.08 ppm SO2, 4 hr/d/wk) in combination with simulated rain (pH 3.0, 4.3 or 5.6 1 hr/d, 2d/wk at 0.75 cm/hr) for 6 wk, with rain applied either just before or after fumigation. Across all rain treatments, O3 + SO2 resulted in a significant decrease in height growth and dry matter production and an increase in leaf area ratio (LAR) compared with controls. The combined effect of O3 and SO2 was additive in nature, except for root dry weight and leaf weight ratio (LWR) in which a greater than additive response was observed. The alteration in LAR was due to dry matter remaining in the leaves as indicated by an increase in LWR. Rain treatments altered leaf dry weight which appeared as a quadratic function across all pollutant treatments. A significant gaseous pollutant x rain pH interaction occurred for root dry weight, leaf area increase, mean relative growth rate (RGR), mean unit leaf rate (ULR) and chlorophyll content. Ozone exposure resulted in a linear decrease in root dry weight, leaf area increase, RGR and ULR, as the acidity of rain increased (decreased pH), whereas fumigation with SO2 resulted in an increase in these growth variables as rain pH decreased. Chlorophyll content increased in both O3 and SO2 treatments as the acidity of rain increased. Fumigation of wet leaves caused a significant reduction in dry matter production, shoot elongation, leaf area, RGR and ULR as compared with dry leaves across all treatments. The results of this study demonstrate that the effects of multiple pollutant stresses are more deleterius than any single pollutant exposure for these half-sib seedling trees. These findings are discussed relative to possible implications on the effects of gaseous pollutants in combination with acidic precipitation on yellow-poplar growth and productivity. (Author's abstract)
W86-01876

CONTAMINANT LEVELS IN COLONIAL WATERBIRDS FROM GREEN BAY AND LAKE MICHIGAN, 1975-80,
G. H. Heinz, T. C. Erdman, S. D. Haseltine, and C. Stafford.
Environmental Monitoring and Assessment, Vol. 3, No. 3, p 223-236, September, 1985. 3 Tab, 29 Ref.

Descriptors: *Water birds, *Pesticide residues, *Halogenated hydrocarbons, *Green Bay, *Lake Michigan, Mercury, Polychlorinated biphenyls, Polybrominated biphenyls, Polychlorinated styrenes, DDE, Dieldrin, Diets, Gulls, Herons, Egrets.

Residues of organochlorine pesticides, polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), polychlorinated styrenes (PCSs), and mercury were measured in the eggs of 10 species of colonial waterbirds nesting in areas around Green Bay or Lake Michigan from 1975 to 1980. Residues also were measured in the carcasses and brains of black-crowned night-herons (Nycticorax nycticorax). The highest residues were of PCBs, DDE, mercury, and dieldrin; for some species, levels of these chemicals possibly were high enough to have caused reproductive effects. Other organochlorine pesticides were found at low levels. Only trace amounts of PCBs and PBBs were found. Eggs of herring gulls (Larus argentatus) collected in 1977 from an island in Lake Michigan contained an average of 100 ppm PCBs and 33 ppm DDE; this was the most-contaminated species. Cattle egrets (Bubulcus ibis), the only bird that is not a fish eater, contained only small quantities of DDE and mercury. (Author's abstract)
W86-01885

INSECTICIDE RESISTANCE IN MOSQUITOFISH OF THE LOWER RIO GRANDE VALLEY OF TEXAS - AN ECOLOGICAL HAZARD,
Columbia National Fisheries Research Lab., Victoria, TX. Field Research Station.
J. K. Andreasen.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 573-577, September, 1985. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Insecticide resistance, *Mosquitofish, *Rio Grande Valley, *Texas, Pesticide toxicity, Genetics, Toxaphene, DDE, Pyrethriod insecticides, Bioaccumulation, Insecticides, Water pollution effects.

Large-scale agricultural development in the Lower Rio Grande Valley makes this an ideal location for examining genetic resistance in fish populations. Acute toxicity tests using mosquitofish showed that a population from the Lower Rio Grande Valley of Texas had developed resistance to toxaphene and cross resistance to DDE but not to pyrethroid insecticides. At toxaphene exposure concentrations up to 4,000 micro-g/l (4 ppm) about 30% of the fish from the Lower Rio Grande Valley survived and the 96 hr LC50 was estimated to be 790 micro-g/l. Control mosquitofish that had no known pesticide exposure did not survive at toxaphene concentrations greater than 32 micro-g/

l, and the 96 hr LC50 was 6.5 micro-g/l. Tests with progeny from resistant parents showed that the F1 generation was also resistant. Resistant mosquitofish bioaccumulate large body residues of organochlorine pesticides that apparently cause no problems for mosquitofish. Consumption of resistant fish may be hazardous to fish or avian predators and may be one factor contributing to an overall population decline of some species in southern Texas. The ability to develop cross resistance may preadapt a population to certain pesticides and thereby create a potentially hazardous situation when new chemicals are introduced. (Moore-IVI)
W86-01889

CONTAMINANT RESIDUES IN FISH AND SEDIMENTS FROM LAKES IN THE ATCHAFALAYA RIVER BASIN (LOUISIANA),
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5B.
W86-01890

EFFECT OF TOLUENE ON FATHEAD MINNOW (PIMEPHALES PROMELAS RAFINESQUE) DEVELOPMENT,
Washington Univ., Seattle. Dept. of Pathology.
E. W. Devlin, J. D. Brammer, and R. L. Puyear.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 595-603, September, 1985. 4 Fig, 1 Tab, 42 Ref. Air Force grant AFOSR-78-3709 and NIH grant 5T32ESO7032.

Descriptors: *Toluene, *Fathead minnows, *Embryos, *Toxicity, Hydrocarbons, Aromatic compounds, Water pollution effects, Immature growth stages.

A category of highly refined petroleum products which represent a potential source of contamination is jet fuel. Toluene is a major aromatic in the water-soluble fraction of the jet fuel JP-4. The effect of toluene on teleost development was examined under controlled conditions. Young fathead minnow embryos 1-2 hr old were continuously exposed to 30-45 mg/l toluene for 14 to 124 hr. Live embryos as well as serial sections of paraffin-embedded embryos were examined to determine effects of the toxicant. Abnormalities noted under these conditions included distorted embryonic axis, abnormal heart and circulatory system development, hydration and swelling of the pericardial coelom, hemorrhaging, and overall stunted appearance, microphthalmia, and a unique migration of the ventrally located yolk syncytial layer and its associated nuclei. Toluene concentration necessary to elicit morphological responses were high, and may be approached in the environment only under extreme conditions such as a major spill in a confined area. (Moore-IVI)
W86-01892

INHIBITION OF GROWTH OF FRESHWATER MICROALGAE BY LONG-CHAINED ALIPHATIC AMINES EMPLOYED IN SOLVENT EXTRACTION PROCESSES,
Goeteborg Univ. (Sweden). Dept. of Botany.
H. Blanck.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 609-620, September, 1985. 4 Fig, 7 Tab, 48 Ref.

Descriptors: *Aliphatic amines, *Algal growth, *Phytotoxicity, *Solvent extraction, Bioassay, Diatoms, Cyanophyta, Chlorophyta, Amines, Water pollution effects, Industrial wastewater.

The influence on algal growth by six longchained aliphatic amines, used in industrial solvent extraction processes, was investigated by a conventional algal assay and, in addition, a simple assay where algae were grown in liquid medium in 250 micro-l cultures on microtitration plates. Loss of solvent extractants from processes to ambient water represent a potential environment problem. The primary, secondary, tertiary and quaternary amines (with one exception) had EC50-values based on growth rate (ECr) or algal biomass (ECb) at 0.01-0.3 mg/l (20-800 nM). This makes long-chained aliphatic amines about a thousand times more toxic than short-chained amines on a molar basis. The difference in toxicity was interpreted as being due to different modes of action between the two groups of amines. The diatom Asterionella formosa and the blue-green algae Anabaena flos-aquae were more sensitive to the amines than the green-algae Selenastrum capricornutum, Monoraphidium pusillum or Chlorella emersonii. The maximum ECma/ECmin ratio recorded was 19.5, for the primary amine. Anabaena flos-aquae was more sensitive by a factor 2-4 when grown under nitrogen fixation conditions than when supplied with combined nitrogen. Compared to other aquatic organisms, the algae show a particular sensitivity to amines. The microtitration test system was less sensitive than the flask test system. The low sensitivity of the microtitration test system is not an inherent property, but due to the use of an insensitive technique (visual inspection) for detection of algal biomass. The ECr50 and ECb50-values in the flask test system were both heavily time-dependent. (Author's abstract)
W86-01893

LYSOSOMAL ENZYME RELEASE IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS RAFINESQUE) EXPOSED TO CADMIUM,
Michigan State Univ., East Lansing. Pesticide Research Center.
D. J. Versteeg, and J. P. Giesy.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 631-640, September, 1985. 9 Tab, 50 Ref.

Descriptors: *Sunfish, *Cadmium, *Enzymes, Toxicity, Water pollution effects, Stress, Starvation, Biological magnification, Bioaccumulation.

Lysosomal membrane lability and enzyme activities were measured in gill and liver tissues of the bluegill sunfish (Lepomis macrochirus). Exposure to sublethal cadmium concentrations for 10 or 21 days resulted in significant increases in the lability of liver lysosomal membranes, as measured by release of N-acetyl-Beta-D-glucosaminidase (NAG) and acid phosphatase (ACP). Acid phosphatase and NAG activites in liver were decreased by 10 day exposure to cadmium. However, after 21 days of exposure, liver NAG activity was elevated. Cadmium exposure did not affect the lysosomal lability index or the total enzyme activity of lysosomes isolated from gill tissue. In vitro exposure of isolated liver lysosomes to cadmium demonstrated that the increase in membrane lability was not a direct effect of cadmium on the lysosome. Stress induced by crowding the fish had no effect on liver lysosomal membrane lability. Starved bluegill sunfish had significantly destabilized lysosomes, as measured by both NAG and ACP. However, starvation did not affect the total activity of either enzyme. Neither size nor sex had any affect on lysosomal membrane lability, which indicates that field experiments will not be confounded by these factors. The problem of metal bioconcentration in fish has created the need for diagnostic tests which can be utilized to understand the biological effects of these contaminants on fish. The lysosomal membrane lability assay currently holds promise for use as a health monitoring tool. (Author's abstract)
W86-01894

ACTIVATION OF POLYCYCLIC AROMATIC HYDROCARBONS BY HEPATIC S-9 FROM A MARINE FISH,
North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
D. M. Milling, and M. B. Maddock.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 301-307, September, 1985. 2 Fig, 13 Ref. EPA Grant R811134.

Descriptors: *Polycyclic aromatic hydrocarbons, *Activation, *Fish, Hydrocarbons, Aromatic compounds, Aquatic life, Genotoxicity, Water pollution effects, Organic compounds.

The possibilities for monitoring aquatic systems for genotoxic hazards, including polycyclic aromatic hydrocarbons (PAH's) with cytogenetic assays of feral fish are being examined. Possible differences in metabolism by fish and mammalian systems or by different fish systems can influence the genetic effects of metabolism dependent genotoxic chemicals, such as the PAH's. A preliminary indication of the ability of toadfish S-9 to activate a series of weakly carcinogenic and mutagenic PAH's in the Salmonella assay was undertaken. The first experiment was designed to provide information on the mutagenicities in plate assays of single concentrations of four PHA's to Salmonella strains TA1527, TA1538, TA98,and TA100 with increasing concentrations of S-9 from untreated and 3-methylchlanthrene-pretreated toadfish. Comparison of the results of this study with toadfish S-9 and available data for mammalia S-9 does not suggest substantial differences in the ability to activate the PAH's tested. (Baker-IVI)
W86-01896

ACUTE TOXICITY OF FOUR PHENOXY HERBICIDES TO AQUATIC ORGANISMS,
Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology.
H. C. Alexander, F. M. Gersich, and M. A. Mayes.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 314-321, September, 1985. 4 Tab, 12 Ref.

Descriptors: *Herbicides, *Toxicity, *Phenoxy compounds, *Water pollution effects, Organic compounds, Aquatic life, Daphnia, Fish, Mortality.

The herbicides tested include 2,4-D, 2,4-D dimethylamine salt, 2,4-D isooctyl ester, and MXPA isooctyl ester. The 2,4-D isooctyl ester and MCPA isooctyl ester were not toxic to aquatic organisms (daphnia and fish) at their water solubility levels, 0.006 mg/l and 0.003 mg/l, respectively. Fish mortality observed in this study were attributed to low pH values, well within the range reported as being lethal to fish. Differences in acute toxicity values reported for 2,4-D on both invertebrates and fishes could be due to water quality. The daphnid acute toxicity value from this study for 2,4-D dimethylamine salt is significantly higher than earlier studies. Conversely, the acute fish toxicity of 2,4-D dimethylamine salt reported in this study and others was similar. The 2,4-D isooctyl ester has a low water solubility and exhibited no acute toxicity to aquatic organisms at nominal concentrations up to 1,000 times its water solubility. The acute toxicity data from these studies may be used to predict toxicity to aquatic life as a result of an accidental spill to the environment. (Baker-IVI)
W86-01898

METALS AND PCB CONCENTRATIONS IN MUSSELS FROM LONG ISLAND SOUND,
National Marine Fisheries Service, Milford, CT. Milford Lab.
R. A. Greig, and G. Sennefelder.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 331-334, September, 1985. 2 Tab.

Descriptors: *Polychlorinated biphenyls, *Metals, *Mussels, *Long Island Sound, Cadmium, Copper, Heavy metals, Water pollution.

Mussels were collected from the mouths of various rivers and inshore areas along the Connecticut shoreline and analyzed for cadmium, copper, and polychlorinated biphenyls (PCBs). Levels of PCBs in mussels from all ten stations sampled were low, ranging from a mean of 0.049 to 0.115 ppm wet weight. Mussel samples from six stations ranged in PCB levels from 0.049 to 0 068 ppm, whereas mussels from the remaining four stations ranged from 0.084 to 0.115 ppm. From a public health standpoint, both concentrations are quite low compared to the 5 ppm limit set by the FDA for PCBs in fish and shellfish. Copper levels were also low in all mussel samples, with means ranging from 1.0 to 2.3 ppm. Mussels from only two stations had the lower levels of 1.0 and 1.1 Cu, whereas mussels from the other stations had levels in the range of 1.7 to 2.3 ppm. The levels of cadmium in mussels were low, with the exception of those taken from Bridgeport where the mussels had a mean level of 5.1 ppm. Mussels from the other stations had mean

levels of cadmium ranging from 0.41 to 1.3 ppm. (Baker-IVI)
W86-01900

EFFECT OF SELENITE ON THE UPTAKE OF METHYLMERCURY IN COD (GADUS MORHUA),
Fiskeridirektoratet, Bergen (Norway). Inst. of Nutrition.
O. Ringdal, and K. Julshamn.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 335-344, September, 1985. 4 Tab, 18 Ref.

Descriptors: *Selenium, *Methylmercury, *Cod, *Fish, *Metals, *Mercury compounds, Toxicity, Water pollution effects, Heavy metals.

The possible interaction of methylmercury and selenium in different tissues of cod and in feeding diets supplemented with nontoxic levels of the elements was examined. There were no significant differences in the mercury uptake in the muscle between the groups with methylmercury exposure. The mercury concentration in muscle increased steadily in all three groups during the whole experimental period. The selenium supplement did not seem to influence the mercury uptake, quantitatively or with regard to the uptake rate in the muscle. Among the three tissues analyzed, the muscle accumulated the highest concentrations of mercury during the 32 days of exposure without selenium supplementation. The mercury concentration in the liver in one group increased to approximately 0.62 mg/kg after 8 days, and this level was constant through the rest of the experimental period. The total uptake of mercury in the brain increased with the selenium supplementation. While these experiments can offer no information on the mechanism of a methylmercury-selenium interaction in cod, the results indicate such an effect through the altered uptake of these elements in the liver and the brain. (Baker-IVI)
W86-01901

ABSORPTION OF CU++ BY LONG-TERM CULTURES OF DUNALIELLA SALINA, D. TERTIOLECTA, AND D. VIRIDIS,
Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
B. Lustigman, J. Korky, A. Zabady, and J. M. McCormick.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 362-367, September, 1985. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Copper, *Absorption, *Salinity, *Algae, *Metals, Aquatic plants, Fate of pollutants, Path of pollutants, Plasmalemma permeability.

The effect of salinity on the absorption of copper by algae was studied by means of atomic absorption analysis. Long term cultures of Dunaliella were used to determine if alterations in plasmalemma permeability occur as a result of adaptation to different osmotic conditions. Since copper appears to affect the mechanisms involved in osmotic resistance, Dunaliella does not exclude copper from the cell. As the extracellular concentration of Cu(++) increases, the intracellular accumulation rises proportionately, so that the intracellular Cu(++) is greater at 50 ppm than in the controls. The resistance of Dunaliella to heavy metals does not appear to be due to exclusion from the cells. Salinity has a significant effect on the amount of copper accumulated by the algal cells. The presence of TRIS in the medium acts to chelate Cu(++) and maintain its concentration to a steady level throughout the experiment. Copper binds to the cell surface and therefore causes alteration of the transport systems. In hypotonic medium the cells remained swollen, while in hypertonic they failed to shrink. Greater permeability in hyposaline medium than in hypersaline, is indicated by the increased absorption of copper into the 2%S cultures than the 6%S. The increased lethality in hypotonic medium may be due to increased water in flux or to greater permeability of copper into the critical regions of the cell. The inverse relationship of salinity and copper permeability may apply to other heavy metal ions as well, which may help to explain the resistance of Dunaliella to heavy metal toxicity. (Baker-IVI)
W86-01904

5D. Waste Treatment Processes

COLOR REMOVAL PROCESS FOR KRAFT PULP AND PAPER MILL EFFLUENTS,
Lakehead Univ., Thunder Bay (Ontario). School of Engineering.
R. G. Rosehart.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 275-284, July, 1985. 5 Fig, 5 Tab, 8 Ref.

Descriptors: *Kraft mills, *Pulp Wastes, *Wastewater treatment, *Color removal, Sulfates, Chemical oxygen demand, Co-precipitation, Aluminum, Calcium, Chemical treatment.

An optimized co-precipitation process for color removal from Kraft pulp and paper mill effluents is described. A split addition process with 115 mg/L Al(+3) and 500 mg/L Ca(+2) appeared to be optimal with a removal percentage of 90.2. The addition of small amounts of a polyelectrolyte A did result in some nominal improvement over the standard process. An Al(+3)/Ca(+2) ratio of 0.23 appeared to give optimal results with the final pH in the 4 to 5 range. Dried sludge produced from the process had a reasonable energy value when combusted in a bomb calorimeter. The chemicals used in the suggested process are commonly available in most kraft mills. For pH control use is made of the acid effluent streams within the mill. Significant COD and hence BOD5 reductions take place during the process which may result in some operational savings during biological secondary treatment. Further development work is needed on a pilot plant scale to further optimize chemical addition rates and conditions and to optimize the mixing and temperature conditions of operation. (Baker-IVI)
W86-01355

NUMERICAL SIMULATION OF RECTANGULAR SETTLING TANKS,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
S. M. Abdel-Gawad, and J. A. McCorquodale.
Journal of Hydraulic Research, Vol. 23, No. 2, p 85-100, 1985. 7 Fig, 1 Tab, 24 Ref, 1 Append.

Descriptors: *Settling tanks, *Wastewater treatment, Sedimentation, Model studies, Simulation, Hydrodynamics, Strip integral method, Sediment transport.

The strip integral method (SIM) is proposed as a simple, and computationally efficient approach to simulate the steady hydrodyamics and sediment transport in settling tanks operating in a neutral density environment. The method assumes a dominant flow direction; the partial differential equations are first reduced by partial integration to a system of ordinary differential equations in terms of a few preselected parameters which are functions of the independent variable, x. These equations are then integrated by methods like Runge-Kutta to give the velocity, the concentration profiles along the tank length and consequently the tank removal efficiency. The method requires the modeller to choose suitable shape functions and to perform the partial integrations. The shape functions given are valid only for tanks that have geometries similar to that demonstrated. Other tank geometries require different shape functions. Work is now in progress to provide more shape functions for different inlet conditions. The method can adequately simulate the major flow features in the tank, the mixing characteristics, the concentration distribution and the removal efficiency. The stability and convergence of the SIM is determined by the number and form of the shape functions; the Runge-Kutta solution is affected by changing the integration step and the order of the truncation error. (Baker-IVI)
W86-01390

EXPERIMENTAL MANIPULATION OF NUTRIENTS AND WATER IN A FRESHWATER MARSH: EFFECTS ON BIOMASS, DECOMPOSITION, AND NUTRIENT ACCUMULATION,
Manitoba Univ., Winnipeg. Dept. of Botany.
S. E. Bayley, J. Zoltek, A. J. Hermann, T. J. Dolan, and L. Tortora.
Limnology and Oceanography, Vol. 30, No. 3, p 500-512, May, 1985. 6 Fig, 6 Tab, 25 Ref.

Descriptors: *Nutrients, *Marshes, *Biomass, *Decomposition, *Wastewater disposal, Peat, Wetlands, Phosphorus, Environmental effects, Water level.

Experimental freshwater marsh plots (2,000 sq m) received 9.6, 3.7, and 1.5 cm/wk of treated sewage effluent and the control plot received 4.4 cm/wk potable water during a 2-year study. Surface water elevation above the peat substrate averaged 0.2 m in the second year. During the first year the marsh surface remained dry. Application of treated effluent increased net primary production only during the dry year. During the wet year there was no significant difference between the highest effluent plot and the control plot in aboveground biomass, or in phosphorus content in the aboveground live or dead vegetation and in the belowground vegetation. Based on the 2 years of the study, a natural increase in water level above the marsh surface had the same effect on the marsh production and nutrient accumulation as did application of 42 g P/sq m/yr in treated effluent. This was presumably due to the release of P from the peat substrate under flooded conditions. (Author's abstract)
W86-01414

RUSSIAN STUDY: CLO2, OXIDATION OF CYANIDES AND PHENOLS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
A. N. Belevzev, and Yu. L. Maximenko.
Effluent and Water Treatment Journal, Vol. 25, No. 5, p 151-176, May, 1985. 9 Fig.

Descriptors: *Phenols, *Wastewater treatment, *Cyanides, *Chlorine dioxide, Oxidation, Quinones, Chlorination, Chemical reactions, Hydrocarbons.

The oxidation process rate of diatomic phenols, and quinones, depends on the interarrangements of hydroxyl groups and quinone grouping. The benzol ring of phenol or proper quinone is less subjected to breaking up under chlorine dioxide action if hydroxyl groups, or quinone grouping, are in para-position relative to each other and they are destroyed more readily when the group arrangement is reproduced either in the meta position or in ortho position. Methyl-derivatives of quinone do not undergo destruction. Phenols having methyl substituents in side chains are oxidized only to methyl-quinone. The chlorine dioxide effect on waste effluents containing some specific substances was examined. The biochemically treated refinery plant effluents that contained non-oxidized oily hydrocarbons and products with various degrees of oxidation were affected by chlorine dioxide. Experiments showed that the substances retained in the waste effluents detailed are oxidized only in the presence of a large excess quantity of ClO2; with maximum effect in strong alkaline media. Removing COD by 90-95% is achieved by using chlorine dioxide at a rate of 800-1000 mg/l. Phenols contained in biochemically treated refinery plant effluents in small concentrations (0.1 to 1 mg/l) are effectively oxidized by chlorine dioxide. Their complete oxidation is obtained at ClO2 rate of 5 mg/l over the period of 10-15 minutes. The results of comparative tests on phenol oxidation by calcium hydrochlorite in the same effluent indicated that to achieve the same effect the activated chlorine required was twenty times greater. Therefore chlorine dioxide utilization holds much promise for advanced treatment of wastewaters with phenols content in small concentrations. (Baker-IVI)
W86-01440

REVERSE OSMOSIS AND ULTRAFILTRATION SOLVE SEPARATION PROBLEMS,
Clemson Univ., SC.
C. H. Gooding.
Chemical Engineering, Vol. 92, No. 1, p 56-62, January, 1985. 87 Fig, 3 Ref.

Descriptors: *Reverse osmosis, *Ultrafiltration, Water treatment, Wastewater treatment, Water reuse, Membrane processes, Membranes, Filtration, Evaporation.

The basic principles of membrane separation are reviewed and approaches are suggested to design considerations and selection of membranes and equipment for specific jobs. A separation process is normally selected on the basis of experience and an economic evaluation of the alternatives. Analysis using osmosis and reverse osmosis assumes that the membrane is impermeable to the solute, at least in comparison to the rate of solvent permeation. Ultrafiltration obeys the same basic principle, and usually implies the separation of macromolecules from relatively low molecular weight solvents. One important factor to consider is the sensitivity of membrane permeability to factors other than temperature. Aside from concentration polarization, which represents a reduction in driving force, membrane permeability is subject to decline due to precipitation of supersaturated solute and to deposition of gels and fine particulate debris that may enter inadvertently with the feed. There are several design criteria to be kept in mind in selecting RO equipment. A high membrane-surface-to-volume ratio is good to minimize space requirements and capital cost. Adequate structural support is needed to allow the thin membrane to withstand the required pressure drop. Low pressure drop on the concentrate side of the membrane maintains the driving force for permeation. Turbulent flow on the concentrate side or some alternative means is needed to dissipate concentration polarization and minimize fouling. Ease of backflushing and/or ease of membrane replacement is needed in the event that fouling becomes a problem. Long membrane life and low replacement cost should also be considered. (Baker-IVI)
W86-01441

WASTEWATER TREATING AT LANZHOU,
Lanzhou Refinery (China).
L. X. Lie.
Hydrocarbon Processing, Vol. 64, No. 6, p 78-79, June, 1985. 3 Fig, 2 Tab.

Descriptors: *Wastewater treatment facilities, *Lanzhou, *China (Peoples Republic) *Refineries, Tertiary wastewater treatment, Chemical oxygen demand, Equalization, Flotation, Activated sludge treatment, Filtration, Activated carbon.

Lanzhou refinery is a modern, integrated petrochemical enterprise in Gans Province, the Peoples Republic of China. The principal purpose of refineries in China is to provide feedstocks for chemical units. A process wastewater treatment system with a hydraulic capacity of 1,200 t/h was constructed in 1980 to decontaminate the industrial wastewater, to protect the Yellow River. The overall refinery process water treatment scheme consists of the following sequential operations: equalization; oil/water/solids separation; chemical coagulation/dissolved air flotation; activated sludge treatment; sand filtration, and granular activated carbon adsorption. Ancillary operations include sludge thickening, incineration and activated carbon regeneration. The quality of process wastewaters varies widely. By using tertiary treatment, the effluent quality does achieve the required national emission standards and approaches surface water quality. Over 30% of the treated effluent is reused as nonprocess water. An unusual feature of the treatment plant is that it is the site of an attractive park for employees with a fountain fed by plant effluent. (Baker-IVI)
W86-01442

TREATMENT OF WASTEWATER BY APPLICATION TO FOREST LAND,
Georgia Univ., Brunswick. Marine Extension Service.
W. L. Nutter, and J. L. Red.
Tappi Journal, Vol. 68, No. 6, p 114-117, June, 1985. 3 Tab, 11 Ref.

Descriptors: *Land disposal, *Wastewater disposal, *Forest watersheds, Industrial wastes, Municipal wastewater, Leaching, Wastewater renovation.

Forest land across the United States is receiving a variety of industrial and municipal wastewaters. This is particularly true in the Southeast where the availability of forest land makes this method of wastewater disposal particularly attractive. With proper design and operation procedures, drinking water standards for groundwater can be met, tree growth improved, and soil properties also improved. Three general pathways for water assimilation by land treatment are identified as biological degradation and/or plant uptake, accumulation in the soil, and leaching of mobile and nondegradable compounds to subsurface waters. The Unicoi forest is described as an example of a system that maintains excellent surface soil hydraulic properties, permitting all wastewater to infiltrate. If the soil is not disturbed during harvesting, the permeability will not be affected and wastewater loading can be maintained. The nutrient status of the soil has improved with wastewater application. The increased nutrient availability also resulted in significant increases in vegetation growth. Renovation of wastewater constituents meets applicable standards for each of the three categories of assimilation pathways: biological degradation and/or plant uptake, accumulation in the soil, and leaching of mobile and nondegradable compounds. (Baker-IVI)
W86-01464

EFFECT OF REACTOR TURBULENCE ON THE BINDING-PROTEIN-MEDIATED ASPARTATE TRANSPORT SYSTEM IN THIN WASTEWATER BIOFILMS,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
T. T. Eighmy, and P. L. Bishop.
Applied and Environmental Microbiology, Vol. 50, No. 1, p 120-124, July, 1985. 3 Fig, 1 Tab, 38 Ref.

Descriptors: *Biological wastewater treatment, *Reactor turbulence, *Biofilms, *Aspartate, Shear stress, Bacteria, Turbulence, Transport systems.

This research documents an effect of reactor turbulence on the ability of gram-negative wastewater biofilm bacteria to actively transport L-aspartate via a binding-protein-mediated transport system. Biofilms which were not preadapted to turbulence and which possessed two separate and distinct aspartate transport systems (systems 1 and 2) were subjected to a turbulent flow condition in a hydrodynamically defined closed-loop reactor system. A shear stress treatment of 3.1 N /sq m for 10 min at a turbulent Reynolds number (Re = 11,297) inactivated the low-affinity, high-capacity binding-protein-mediated transport system (system 2) and resolved the high-affinity, low-capacity membrane-bound proton symport system (system 1). The Kt and Vmax values for the resolved system were statistically similar to Kt and Vmax values for system 1 when system 2 was inactivated either by osmotic shock or arsenate, two treatments which are known to inactivate binding-protein-mediated transport systems. It is hypothesized that shear stress disrupts system 2 by deforming the outer membranes of the firmly adhered gram-negative bacteria. (Author's abstract)
W86-01482

MATHEMATICAL SIMULATION OF A BIOFILM PROCESS,
Auburn Univ., AL. Dept. of Civil Engineering.
L. Benefield, and F. Molz.
Biotechnology and Bioengineering, Vol. 27, No. 7, p 921-931, July, 1985. 12 Fig, 1 Tab, 32 Ref.

Descriptors: *Biological wastewater treatment, *Biofilms, *Mathematical models, Simulation, Fixed-film process, Diffusion, Oxygen, Organic compounds, Differential equations.

A mathematical model has been developed for a fixed-film biological process (film flow over a flat plate) that describes bulk liquid transport, diffusional transport of oxygen and organics across a stagnant film, diffusional transport of oxygen and organics into the biofilm, biochemical reactions by the individual cells within the biofilm, biofilm growth, and cell density changes within the biofilm due to cellular decay. The model consists of two partial differential equations and three ordinary differential equations. It was assumed for model development that a lack of either organics or oxygen, or both simultaneously could limit the rate of the metabolic reactions. The two sets of differential equations are themselves coupled by a mass balance around the diffusion layer. The response of the model is illustrated through a numerical solution to the system of five differential equations using specified parameter values. The model illustrates how loading, contact time, biofilm thickness, diffusion layer thickness, and oxygen concentration interact to effect organics removal in a fixed film process. Although the model is developed specifically for film flow over a flat plate, the general system response (in a qualitative sense) due to changes in contact time and diffusion layer thickness will be similar for any film flow biofilm process. (Moore-IVI)
W86-01484

TRAINING: THE BRIDGE BETWEEN TREATMENT AND TECHNOLOGY,
B. Quinn.
American City and County, Vol. 100, No. 2, p 52-54, February, 1985. 2 Fig.

Descriptors: *Wastewater treatment, *Financial aspects, *Training, Education, Management, Operations, Public information.

Training is essential for wastewater treatment and disposal plant operators in light of more stringent regulations being placed on these facilities. It is critical for all operating personnel to understand what the system is as a whole and what it is designed to accomplish. Job-specific training is also needed in light of the introduction of various advanced technologies in wastewater treatment. Frequently those who find themselves in positions of managers, have risen through the ranks and have not had the advantages incurred through management training programs. This is another area of training which needs to be implemented in many water treatment facilities. With training being such an obvious need, the reason why it is so often lacking comes down to available money. Far too often the public feels its responsibility for funding ends once the construction of a wastewater treatment plant is complete. The public needs to be educated about the importance of protecting its investment. (Baker-IVI)
W86-01489

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,
W. T. Lorenz.
American City and County, Vol. 100, No. 2, p 56-58, February, 1985. 1 Fig.

Descriptors: *Wastewater treatment, *Economic aspects, Membrane processes, Computers, Automation, Wastewater treatment facilities, Water reuse, Financing, Management.

Public officials are evaluating innovative and cost-effective technologies, as well as exploring alternative financing methods to meet the ever pressing demands for community wastewater treatment needs. Package wastewater treatment plants have been accepted for years as one solution to sewage treatment problems. Membrane technologies, as part of package treatment plants, are also in greater demand where higher quality effluent is desired, perhaps for recycling or reuse. There is a growing demand for instrumentation and sampling systems for monitoring the compositions and concentrations of substances found in influent resulting from industrial waste streams. Computer based services and software are fast becoming an important part of the water and wastewater treatment industry.

For small treatment plants, the tend is toward onsite microcomputer operations that can reduce staff requirements by as much as 75%. Significant progress in water recycling is now underway, due to improved economics, tighter water supplies and tradeoffs between treating water supplies and recycling. Two major obstacles to this thought are the high costs and the potential health hazards posed by reclaimed water. Many public officials are now realizing the need for a business approach to financing and managing municipal wastewater treatment systems. As that market grows, public officials will have to keep informed of the benefits and it falls of the changing technology in order to make the best decision for the advancement of wastewater treatment projects in their communities. (Baker-IVI)
W86-01490

STUDIES ON THE POLLUTION CONTROL OF THE YA-ER LAKE (IN CHINESE),
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W86-01513

SEEKING TREATMENT; SEWAGE SOLUTIONS IN SAN DIEGO,
W. P. Deddeh.
Oceans, Vol. 18, No. 4, p 63-64, July-August, 1985.

Descriptors: *Tijuana, *Mexico, *San Diego, *California, *Wastewater treatment, Municipal wastewater, Filtration, Public health, Water reuse, Wastewater renovation.

The problems of sewage spills and ocean disposal methods have caused grave concern among environmentalists, legislators, and government officials about the ecological balance of marine life. San Diego, California has a unique problem caused by the neighboring Mexican city of Tijuana. Lack of adequate sewage collection, treatment and disposal facilities in Tijuana have had a serious impact on San Diego's beaches and on the Tijuana River. It is unlikely that the sewage situation in Mexico will improve. Currently, under an agreement between the US and Mexico, San Diego treats 15 million gallons/day (MGD) of Tijuana's raw sewage at the Point Loma plant. The remainder, two MGD, is pumped to an ocean discharge point about three miles south of the border. The Tijuana sewage pipe breaks have forced beach quarantines for 307 days in 1981, 219 days in 1982, and 294 days in 1983. Holding ponds have been established which offer a temporary remedy to the situation. One alternative to the construction of a larger pipeline to the Point Loma plant which seems to have the backing of environmentalists and a number of engineers is one which uses a static screening process and plastic media, roughing filters, developed for industrial wastewater treatment. The screen and filter approach also does away with the need to build costly ocean outfalls for ocean discharge and allows the treated waste water to be used for reclamation projects in agriculture or industry. (Baker-IVI)
W86-01540

CASE STUDY ANALYSIS FOR SEASONAL NITRIFICATION: ECONOMIC EFFICIENCY AND WATER QUALITY PRESERVATION,
Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
R. A. Ferrara, and M. A. Dimino.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 763-769, July, 1985. 5 Fig, 6 Tab, 6 Ref.

Descriptors: *Nitrification, *Economic aspects, *Wastewater treatment, *Water quality control, Seasonal variation, Water treatment facilities.

A case analysis demonstrated the elements of a cost effective wasteload allocation procedure for wastewater discharges. For many advanced wastewater treatment facilities, a single year-round effluent limitation is imposed. That limitation is normally based on maintenance of water quality standards during critical conditions of low waste assimilative capacity in the receiving water. Generally this critical condition occurs less than 1% of the time, and therefore these treatment facilities are required to be designed and operated to provide effluent quality far in excess of that necessary to preserve water quality most of the time. A practical approach for biological treatment systems is to assign seasonally varying effluent limitations. The approach is particularly appropriate for nitrification systems because of decreased rates of nitrification and lower ammonia toxicity in the receiving water during cooler times of the year. A statistically determined winter low flow criterion was proposed as the appropriate analog to the conventional 7 day 10 year low flow. In this case study, the annual operation and maintenance cost savings were substantial. It is recommended that regulatory agencies include these procedures routinely in specifying effluent limitations. Wastewater treatment facilities should be encouraged to reevaluate their methods of operation for innovative ways to minimize the costs of operation while still preserving stream water quality. Any reduction in other advanced treatment requirements that can be technically and economically justified while still preserving receiving water quality standards and uses should also be pursued. (Baker-IVI)
W86-01543

OPERATIONAL DYNAMICS AND CONTROL OF SECONDARY CLARIFIERS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
T. M. Keinath.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 770-776, July, 1985. 13 Fig, 8 Ref.

Descriptors: *Secondary wastewater treatment, *Clarification, Wastewater treatment, Management, Maintenance, Operation.

Solids inventory control strategies have been described for several secondary clarifier overload situations including thickening overloads, and thickening and clarification overloads. A recycle rate control strategy was shown to be effective for thickening overloads and a certain class of thickening and clarification overloads. Effective solids inventory control for situations in which secondary clarifiers are grossly overloaded with respect to both thickening and clarification can be achieved only by applying a step-feed control strategy. Although the graphical approach was used in this research to illustrate various solids inventory control strategies proposed, many treatment plant operators may consider the approach too tedious. Consequently, the control algorithms described were incorporated in a software package designed to control the activated sludge system. This is available under a software package that also includes a data management and comprehensive total maintenance management program. When using the software, the operator inputs only the current influent and recycle flow rates and the MLSS value. The software analyzes the operational state of the system and specifies the type and extent of control action required, if any. This effectively relieves the tedium of the graphical procedure. (Baker-IVI)
W86-01544

PILOT TESTS OF CHLORINATION FACILITY FOR DISINFECTING SECONDARY EFFLUENT,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, R. Warriner, and N. S. N. Ni.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 777-784, July, 1985. 6 Fig, 4 Tab, 15 Ref.

Descriptors: *Secondary wastewater treatment, Wastewater treatment, Water treatment facilities, Chlorination, Model studies, Sulfur dioxide, Economic aspects, Coliform, Bacteria, Water quality control.

A comparison was made of effluent fecal coliform reductions achievable with chlorine application by jet and by conventional diffuser. An initial mixing reactor with an assembly equipped for investigating either jet mixer or diffuser mixer was constructed, and evaluated with secondary effluents. An improved iodometric method involving the back-titration of TRC with coulometrically generated iodine was used to determine the chlorine residuals. The efficiency of chlorination was evaluated based on fecal coliform MPN for various mixing modes and initial chlorine application dosages. Most of the chlorine reduction took place during the initial mixing period of about 30 seconds. Higher reductions occurred with the jets than with the diffuser. Lower chlorine residuals in an improved initial mixing system will reduce sulfur dioxide requirements when dechlorination is required. Although most of the coliform reduction took place during the initial mixing period, significant coliform reduction continued for up to 15 minutes after chlorine application. The initial mixing intensity seemed to affect only the initial kills but not later kills. Based on the data, a regression model was formulated, which incorporated the pertinent variables of inital chlorine dosage and chlorine contact time. Because of the data scatter, the model may best be considered an indication of the relative importance of the time and concentration variables. (Baker-IVI)
W86-01545

FIELD STUDIES OF THE OVERLAND FLOW PROCESS FOR THE TREATMENT OF RAW AND PRIMARY TREATED MUNICIPAL WASTEWATER,
California Univ., Davis. Dept. of Civil Engineering.
R. G. Smith, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 785-794, July, 1985. 12 Fig, 5 Tab, 22 Ref. EPA contract R807757, and California State Water Resources Control Board grant 7-196-41.

Descriptors: *Wastewater treatment, *Overland flow, *Davis, *California, Land disposal, Municipal wastewater, Temperature effects, Precipitation.

A field study was conducted at the city of Davis, California overland flow treatment site. The entire system comprised an area of 65 ha and was divided into 15 zones. Each zone consisted of one pair of opposite facing slopes fed by a central double-gate aluminum pipe, 25.4 cm in diameter. Each slope was 45 m long and 512 m across. All slopes were constructed with a down-slope grade of 2% and a cross slope grade of 0.2%. Studies were conducted with raw wastewater and primary effluent to determine the relationships between overland flow process performance and the parameters application rate and application period. The effects of precipitation and temperature on process performance were also monitored. Model studies based on slope length and application rate lead to predictions of smaller land requirements than current design guidelines have imposed. (Baker-IVI)
W86-01546

RESPONSE OF PHENOL-ACCLIMATED ACTIVATED SLUDGE PROCESS TO QUANTITATIVE SHOCK LOADING,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, and A. F. Gaudy.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 795-804, July, 1985. 9 Fig, 2 Tab, 32 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Phenols, Kinetics, Shock loads, Biological wastewater treatment.

Predictions of system response to quantitative shock loads, using kinetic model equations recommended for activated sludge treatment of toxic wastes, do not accurately depict changes in X and S in the reactor. A similar situation exists with predictive equations for nontoxic substrates. In both cases, certain discrepancies between predicted and observed response occur. These experimental findings support previous recommendations for design and operation of activated sludge systems for treatment of toxic wastes. Laboratory studies

must be performed to evaluate the biokinetic constants and a critical point analysis should be performed to determine the limits of the allowable operating range. It appears from this work that engineers should design for slow specific growth rates when treating toxic substrates. This appears to be even more critical for systems subject to quantitative shock loadings. It seems very important that, in addition to providing for slow specific growth rates, equalization basins to attenuate changes in the concentration of substrate in inflowing feed to a biological reactor and in flow be provided. While phenol can be considered a typical inhibitory substrate, work on other carbon sources would be a welcome addition to the data base. (Baker-IVI)
W86-01547

CHARACTERIZATION OF THE SIZE DISTRIBUTION OF CONTAMINANTS IN WASTEWATER: TREATMENT AND REUSE IMPLICATIONS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
A. D. Levine, G. Tchobanoglous, and T. Asano.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 805-816, July, 1985. 16 Fig, 7 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Pollutants, Particle size, Size distribution, Organic matter, Water reuse, Wastewater facilities.

The types and sizes of the organic matter in wastewater and their relationship to treatment are discussed along with techniques for characterizing particle size distributions in wastewater, the impacts of treatment on particle size distribution, and the implications of particle size in evaluating and designing treatment and reuse facilities. The organic contaminants in municipal wastewater can be effectively classified as either greater than or less than 0.1 micro-m. The size of the organic particulate matter in settled municipal wastewater ranges from about 0.1 to 50 micro-m. The molecular size of organic contaminants smaller than 0.1 micro-m ranges from less than 10 to the 3rd to about 10 to the 7th power amu. The percentage of organic material larger than 0.1 micro-m in settled municipal wastewater ranges from 30 to 85%. The specific percentage will depend on the nature of the community, the length and flow regime in the sewers, whether influent pumping or grit removal is used, and on the design and operating characteristics of the primary sedimentation facilities. The predominant removal mechanisms of most processes for treatment of wastewater contaminants are related to particle size. Appropriate technology can be used to tailor the size distribution of contaminants to meet specific treatment objectives. The incorporation of size distribution analyses into the design process will result in the development of more innovative and cost-effective treatment facilities for wastewater treatment and reuse. The selection, design, and operation of wastewater treatment facilities can be improved by using a design procedure that incorporates the concept of particle size management. (Baker-IVI)
W86-01548

LIQUID SLUDGE STABILIZATION USING VERMISTABILIZATION,
Texas Univ. at Austin. Dept. of Civil Engineering.
R. C. Loehr, J. H. Martin, and E. F. Neuhauser.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 817-826, July, 1985. 7 Fig, 13 Tab, 18 Ref. NSF grant ISP-8016764.

Descriptors: *Sludge stabilization, *Earthworms, *Vermistabilization, Municipal waste, Sludge, Wastewater treatment, Liquid sludge, Activated sludge.

Basic studies to identify fundamental factors that affect the performance of the vermistabilization process and applied studies to determine design and management relationships were conducted. Earthworms are a key component of the liquid sludge vermistabilization (LSVS) process. Control reactors that did not contain worms failed in a much shorter period of time than did the reactors with the worms. The LSVS reactors that were not overloaded functioned successfully for 140 to 198 days and were stopped only because the project ended. Oxidized nitrogen (nitrates) in the drainage from the LSVS reactors indicates that aerobic conditions were being maintained. Liquid primary sludge and liquid wastes activated sludge can be stabilized by the LSVS process. LSVS reactors were not adversely affected by short term, large variations in loading rates. Liquid primary sludge was stabilized to about the same degree as liquid aerobically digested sludge in the LSVS process. Moisture balances indicated an overall moisture loss of 4 to 20%. Loading rates of about 21000 g/sq m/week volatile solids or less resulted in satisfactory operation of LSVS reactors stabilizing liquid primary and liquid waste activated sludge. Loading rates greater than 1200 g/sq m/week volatile solids can be used for LSVS reactors stabilizing liquid aerobically digested sludge. With LSVS reactors, the disposal of residual stabilized solids occurs at long intervals. The total solids content of the stabilized residual solids in the LSVS reactors was from 14 to 24%, a considerable increase from the 0.6 to 1.3% that was added. LSVS is a successful process for both dewatering and stabilization. The stabilized residual solids had approximately the same characteristics regardless of the type of liquid sludge added to the reactors. Size and cost estimates indicate that LSVS may be an economically feasible sludge management process. (Baker-IVI)
W86-01549

INFLUENCE OF TRANSIENT PHENOMENA ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS I: VARIATIONS IN HYDRAULIC LOADING AND SEWAGE STRENGTH,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. Hunter, T. Stephenson, J. N. Lester, and R. Perry.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 415-430, August, 1985. 6 Fig, 2 Tab, 56 Ref.

Descriptors: *Nitrilotriacetic acid, *Activated sludge process, *Biodegradation, Hydraulic load, Chemical oxygen demand, Temperature effects, Detergent builders.

The removal of nitrilotriacetic acid (NTA) following acclimatization in an activated sludge pilot plant has been studied during transient changes in operating conditions. These changes included increases in hydraulic loading and influent chemical oxygen demand (COD) and such phenomena in combination with transient temperature reductions. Short-term increases in hydraulic loading from 1 to 2 dry weather flow (dwf) had a very limited effect on NTA removal. Increasing the influent COD had a slight effect on NTA removal. Short term increases in hydraulic loading combined with transient reductions in temperature significantly reduced NTA removal. The effect of these combined changes on NTA removal was synergistic, rather than additive. Increases in influent COD combined with transient temperature reductions also caused a significant reduction of NTA removal. The effect of such combined changes on NTA removal was at most only additive. (Author's abstract)
W86-01609

INFLUENCE OF TRANSIENT PHENOMENA ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS II. VARIATIONS IN INFLUENT METAL AND NTA CONCENTRATIONS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
T. Stephenson, R. Perry, and J. N. Lester.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 431-450, August, 1985. 9 Fig, 5 Tab, 56 Ref.

Descriptors: *Nitrilotriacetic acid, *Activated sludge process, *Biodegradation, *Metals, Wastewater treatment, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Detergent builders, Temperature effects.

The removal of Cd, Cr, Cu, Pb, Ni, and Zn in an activated sludge pilot plant acclimatized to nitrilotriacetic acid (NTA) has been compared with an identically operated plant receiving no NTA. During steady-state operation the removal of Pb and Ni was reduced in the presence of NTA but there was no detectable difference in mixed liquor metal concentrations. Transient changes in the influent metal concentration of an order of magnitude had only a slight influence on NTA removal; Ni had the greatest effect, Cd and Cu some effect and Pb a negligible effect. Short term variations in influent NTA concentrations had no effect on NTA removal. A transient increase in influent NTA concentrations caused a slight decrease in NTA removal. Transient increases in influent Ni concentrations combined with reductions in temperature to 10 and 7.5 C had a slight adverse effect on NTA removal. This effect did not appear to be additive or synergistic. Combinations of transient increases in influent NTA concentration and reductions in temperature caused a significant decrease in NTA removal. The effect was synergistic rather than additive. (Author's abstract)
W86-01610

NEW FIELD OF APPLICATION FOR THE ANAMET PROCESS FOR THE PURIFICATION OF INDUSTRIAL WASTEWATER (NEUE ANWENDUNGSGEBIETE DES ANAMET-VERFAHRENS FUR DIE REINIGUNG VON INDUSTRIE-ABWASSERN),
AC Biotechnics A.B., Arloev (Sweden).
B. Hallin.
Chemie-Ingenieur-Technik, Vol. 57, No. 5, p 458-460, May, 1985. 1 Fig, 2 Tab.

Descriptors: *Pulp and paper industry, *Wastewater treatment, *Anamet Process, Industrial wastewater, Pulp wastes, Anaerobic digestion.

The Anamet Process is a anaerobic-aerobic process that was originally developed for the treatment of sugar production wastewater. The newest and most promising application of the Anamet Process concerns the cellulose and paper industry. In general, these wastewaters are more difficult to treat that the wastewaters from the food processing industry. Pilot plant studies were carried out to determine the treatability of cellulose and paper industry wastewaters using the Anamet Process. The first large scale application of the Anamet Process for the treatment of paper mill wastewaters indicates that these wastewaters are treatable using anaerobic methods. (Moore-IVI)
W86-01613

INDUSTRIAL EFFLUENT, HOW TO MINIMISE THE FAILURE,
B. Sidebottom.
Water and Waste Treatment, Vol. 28, No. 6, p 50-52, June, 1985. 3 Fig.

Descriptors: *Wastewater treatment, *Industrial wastewater, Economic aspects, Food-processing industry, Pharmaceutical industry.

Industries where the need to handle liquid waste products is an important, but secondary unproductive and undesirable cost, are considered. These industries include food, pharmaceuticals and manufacturing plants where some chemical process is involved. The first requirement is for the manufacturer to identify and estimate the volume of the waste and the chemical and physical characteristics of its components. The most positive and productive step is to eliminate the creation of waste or pollution products. Consideration is given to the design of the effluent system, commissioning of the plant, and project management and coordination. (Baker-IVI)
W86-01634

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - I; REVIEW OF PREVIOUS RESEARCH,
Pira, Leatherhead (England). Paper and Board Div.

For primary bibliographic entry see Field 5C.
W86-01635

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - II; CHEMICAL ANALYSIS OF MILL EFFLUENTS,
Pira, Leatherhead (England). Paper and Board Div.
For primary bibliographic entry see Field 5C.
W86-01636

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - III; REMOVAL OF SEWAGE FUNGUS-NUTRIENTS,
Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 961-967, 1985. 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Paper wastes, *Wastewater treatment, *Pulp and paper industry, Biological filtration, Activated sludge process, Filtration, Hydrogen peroxide, Glucose.

Pilot scale trials were carried out at two papermills to assess various treatment systems for removal of BOD and effluents: biological filtration through plastic media, activated sludge, multi-media mechanical filtration and hydrogen peroxide addition. Despite some operating difficulties in both cases, activated sludge treatment and biological filtration are capable of substantial reductions in the concentrations of both BOD and sewage fungus nutrients. Mechanical filtration through graded media had no controlling effect on sewage fungus growth produced by clarified or activated sludge effluents; in the case of the primary clarified effluent, some increase in the concentration of glucose (a proven sewage fungus nutrient at this mill) was observed on filtration. On both a laboratory and pilot scale, treatment of clarified effluent with hydrogen peroxide plus ferrous sulfate reduced glucose levels substantially, but the effect on sewage fungus in experimental channels was less clear due to a low level of growth produced at this time by the control, untreated clarified effluent. (Moore-IVI)
W86-01637

CONTROL OF ACTIVATED SLUDGE FILAMENTOUS BULKING - VI; FORMULATION OF BASIC PRINCIPLES,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba.
Water Research, Vol. 19, No. 8, p 1017-1022, 1985. 6 Fig, 1 Tab, 48 Ref.

Descriptors: *Bulking sludge, *Activated sludge process, Wastewater treatment, Microorganisms, Bacteria, Biological wastewater treatment, Dissolved oxygen.

Extensive research has been conducted concerning filamentous bulking during the past 20 years in numerous countries. A detailed analysis of these findings enables basic principles to be formulated for controlling filamentous bulking. Filamentous microorganisms are present in any activated sludge. Bulking problems appear when the filaments overgrow the floc-formers. Overgrowing of filamentous microorganisms in activated sludge is affected by composition of treated waste water, actual concentration of dissolved oxygen in an aeration tank, actual concentration of soluble substrate under which microorganisms grow, and technological parameters of the process. The microorganism which accumulates most of the amount of substrate in the selector or in an inlet part of the aeration system will be dominant in this system provided the regeneration period for exhaustion of all the accumulated substrate is sufficient. In the aeration system without separate sludge regeneration, all microorganisms have their accumulation capacities fully restored only at low sludge loadings. Filamentous microorganisms in activated sludge are slow-growers. Floc-forming microorganisms in activated sludge are fast-growers. (Baker-IVI)
W86-01643

USING THE SEWERAGE SYSTEM MAIN CONDUITS FOR BIOLOGICAL TREATMENT; GREATER TEL-AVIV AS A CONCEPTUAL MODEL,
Technion - Israel Inst. of Tech., Haifa. Dept. of Environmental and Water Resources Engineering.
M. Green, G. Shelef, and A. Messing.
Water Research, Vol. 19, No. 8, p 1023-1028, 1985. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Biological wastewater treatment, *Sewer systems, Tel Aviv, Israel, Model studies, Plug-flow reactors, Aeration, Construction costs, Corrosion control, Loop system.

The long-sought idea of using main sewerage conduits as a step-fed plug-flow reactor, where biological sludge is introduced at the head of the main pipelines (hence loop system) and where aeration is provided at various points along the loop, was investigated in this paper in a bench-scale physical model using the Greater Tel-Aviv (Dan Region, Israel) sewerage with design population of 1.3 million and flow of 300,000 cu m/day, as a conceptual model. Due to the inherent advantages of a step-fed plug-flow reactor where high substrate concentrations are maintained along most of the length of the reactor, (except for the final section which provides effluent polishing), the viability of the biomass is 3-5.2-fold higher than the one usually encountered in a conventional activated sludge plant, thus substantially increasing its rate and efficiency of organic substrate removal. It has been shown that in the case of Greater Tel-Aviv, replacing the activated sludge conventional treatment plant with the loop system (with only secondary clarifiers to provide the return biological sludge), or alternatively resorting to the loop system instead of doubling an existing overloaded treatment plant, will produce final effluents well below the requirements of 25 mg/l BOD5 and will provide savings of more than 50% in construction costs. An additional advantage of corrosion control along the main conduits thus increasing their longevity is also discussed. (Author's abstract)
W86-01644

MODELING AND EFFICIENCY OF ULTRAVIOLET DISINFECTION SYSTEMS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls, and J. D. Johnson.
Water Research, Vol. 19, No. 8, p 1039-1046, 1985. 6 Fig, 3 Tab, 24 Ref. EPA grant R80470010, NSF grant CEE82-05274.

Descriptors: *Model studies, *Ultraviolet radiation, *Disinfection, *Wastewater treatment, Bacteria, Dispersion, Efficiency, Ultraviolet disinfection.

Disinfection of wastewater effluents with ultraviolet (u.v.) light has recently become a rapidly growing alternative to chlorination, but there have been difficulties in measuring u.v. dose. A model is presented which predicts bacterial survival in flow-through systems. The calculation takes into account the complex intensity patterns, non-ideal flow patterns, and non-linear curves of log survival vs u.v. dose. Based on the organismal dose-response, the number of survivors in each fraction of the residence time distribution is calculated separately and summed to calculate the average survival. The model uses as input data the average u.v. intensity within the system, the residence time distribution, and an experimentally determined dose-survival curve in a simplified system where dose can be directly measured. The predictions of the model corresponded well with measured survival in a u.v. pilot plant study. The model was used to show the effects of flow dispersion on average survival by varying residence time distribution. Measures of capacity and efficiency of u.v. systems were derived and illustrated experimentally in simple cylindrical batch units and in two multiple lamp units. Model calculations can be a useful tool for research and development of reactor design. (Moore-IVI)
W86-01647

NITROGEN TRANSFORMATIONS AND FATE OF OTHER PARAMETERS IN COLUMNAR DENITRIFICATION,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
N. Biswas, and R. G. Warnock.
Water Research, Vol. 19, No. 8, p 1065-1071, 1985. 4 Fig, 6 Tab, 28 Ref.

Descriptors: *Columnar denitrification, *Wastewater treatment, *Denitrification, Nitrates, Organic carbon, Domestic wastes, Nitrogen, Alkalinity, Attached growth system.

Septic tanks followed by some type of subsurface disposal system have been a common method of wastewater disposal for small communities as well as individual homes for many years. Nitrogen present in wastewater in the form of ammonia is often oxidized to nitrate and causes serious groundwater contamination. A laboratory study was conducted using kitchen waste as the source of organic carbon for denitrification in an attached growth system. Kitchen waste is readily available on site and is inexpensive. Soil columns were used as denitrifying reactors in the laboratory where the feed solutions were composed of nitrified solution and kitchen waste. Five different carbon (expressed as methanol) to nitrogen ratios ranging from 2:2 to 6:1 were applied to twenty soil columns. A high degree of denitrification was obtained for C:N ratios of 4:1 or higher. Rate of application was not a significant factor. Most of the TKN present in the feed solutions escaped the denitrification reactors. The production of total alkalinity during denitrification was somewhat lower than the values reported in the literature. Biological cells were washed out regularly from the soil column and results show that in many cases the column effluents contained higher solids concentrations than the influent. (Moore-IVI)
W86-01650

TURN KEY APPROACH TO CLEAN WATER IN ALABAMA,
Harmon Engineering and Testing, Auburn, AL.
G. R. Harmon.
Current Municipal Problems, Vol. 11, No. 4, p 498-503, Spring, 1985. 18 Ref.

Descriptors: *Water pollution control, *Wastewater treatment, *Alabama, *Auburn, Clean Water Act, Economic aspects, Privatization.

Recent policy statements of the Environmental Protection Agency have directed that municipal wastewater treatment plants will be in compliance with the Clean Water Act, regardless of the availability of Federal monies. Public/private partnerships are emerging nationwide as the answer to the financial dilemma facing many local governments. The entry of private business into the provision of municipal services is not a new concept. Municipalities are finding that private sector financing, or the privatization approach, allows them to provide cost efficient wastewater treatment without exhausting their budget funds and/or borrowing capability to provide the services. Private sector firms are showing a keen interest in funding, and subsequently owning and operating, wastewater treatment and other traditionally public facilities on a turn key basis. Privatization permits the local governments to meet discharge limits, and at the same time, control costs. The investor, too, finds privatization to be an attractive and profitable venture. A specific example of privatization, Auburn, Alabama, is cited as an example of a plan that is working. (Baker-IVI)
W86-01687

REDUCTIVE DECHLORINATION OF THE PESTICIDES 2,4-D, 2,4,5-T, AND PENTACHLOROPHENOL IN ANAEROBIC SLUDGES,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
M. D. Mikesell, and S. A. Boyd.
Journal of Environmental Quality, Vol. 14, No. 3,

p 337-340, 1985. 4 Fig, 1 Tab, 14 Ref. Dep. of Air Force contract F08635-83-C-0290.

Descriptors: *Dechlorination, *Reduction, *Degradation, *Pesticides, *Dichlorophenoxy acetic acid, *Trichlorophenoxy acetic acid, *Pentachlorophenol, *Trichlorophenol, *Chlorophenols, *Anaerobic treatment, Fate of pollutants, Herbicides, Chlorinated hydrocarbons, Halogenated hydrocarbons, Wastewater treatment.

The degradation of seven chlorinated aromatic compounds in anaerobic sewage sludge from three Michigan communities was examined. The compounds tested were 2,4-D (2,4-dichlorophenoxy acetic acid), 2,4,5-T (2,4,5-trichlorophenoxy acetic acid), PCP (penta-chlorophenol), 2,4,6-trichlorophenol, and 2-, 3-, and 4-chlorophenol. All of the compounds tested were degraded in one or more of the sludges during a 70-d incubation period. Overall, 4-chlorophenol was the most persistent compound tested followed by 3-chlorophenol. The most rapid degradative reactions were cleavage of the ether linkage of the phenoxy acetic acid herbicides, 2,4-D, and 2,4,5-T, and the removal of Cl atoms ortho to the phenolic OH group of the chlorophenols. The initial products of 2,4-D and 2,4,5-T degradation were 4-chlorophenol and 2,4,5-trichlorophenol. Reductive dechlorination of 2,4,5-trichlorophenol (produced from 2,4,5-T) gave 3,4-dichlorophenol and 4-chlorophenol which were the final products of 2,4,5-T degradation. Dechlorination of PCP gave 3,4,5-trichlorophenol as the initial transformation product, and further dechlorination gave 3,5-dichlorophenol as final product of PCP degradation. The Jackson sludge had the greatest capacity to degrade the compounds tested. With the exception of 3- and 4-chlorophenol, all other compounds tested were completely degraded in 7 to 14 d in the Jackson sludge. Mason and Adrian sludges were similar in their degradative pathways overall, but significantly less active than the Jackson sludge. (Author's abstract)
W86-01707

PERFORMANCE OF EXPANDED-BED METHANOGENIC REACTOR,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y.-T. Wang, M. T. Suidan, and B. E. Rittmann.
Journal of Environmental Engineering, Vol. 111, No. 4, p 460-471, August, 1985. 9 Fig, 3 Tab, 16 Ref. U.S. EPA contract EPA R-809750-01.

Descriptors: *Expanded-bed reactors, *Methanogenesis, *Wastewater treatment, *Anaerobic digestion, Biological treatment, Fluidized bed process, Water treatment.

The expanded-bed reactor can achieve high organic removal percentages at low temperatures, even when treating low strength waste at short liquid detention times. A completely mixed, expanded-bed, anaerobic granular activated carbon reactor was operated continuously on synthetic wastewaters in which acetate was the only organic carbon source. Acetic acid was used as the substrate because it is the major metabolic product during the fermentation of organic matter. During 859 days of continuous operation, steady-state performance was achieved for four influent acetate concentrations: 800, 1,600, 3,200, and 6,400 mg/L. Steady-state removal efficiencies of acetate, COD and DOC exceeded 98, 97, and 98%, respectively. By the end of the study period, 99.6% of the feed COD was converted to methane gas, suggesting that biological utilization was the major removal mechanism for acetate in the expanded bed reactor and that the net growth of methanogens was very low. Gas production from the reactor doubled virtually immediately after sudden doubling of the organic load while the aqueous phase concentration did not increase drastically. The completely mixed, expanded-bed GAC reactor may be used to achieve good effluent quality from low-strength and medium strength wastewaters. (Collier-IVI)
W86-01726

CONDITIONING OF ANAEROBICALLY DIGESTED SLUDGE,
Camp, Dresser and McKee, Inc., Raleigh, NC.
For primary bibliographic entry see Field 5E.
W86-01728

RUSSIAN USE OF FLOTATION FOR WASTEWATER TREATMENT,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
N. Myasnikov, L. V. Gandurina, and L. N. Butseva.
Effluent and Water Treatment Journal, Vol. 25, No. 6, p 202-206, June, 1985. 4 Fig, 4 Ref.

Descriptors: *Wastewater treatment, *Flotation, Sediments, Petroleum products, Oil, Fats, Surfactants, Water treatment, Physical properties, Chemical properties, Activated sludge.

Schemes and techniques being used in Russia for oils, fats, petroleum products and surfactants removal from wastewaters by flotation are reviewed. The following kinds of flotation are being used at present for treatment of sediments and activated sludges: compression (pressure), impeller, vacuum, biological, chemical, electric and ionic flotation, froth separation. For the sake of further development of methods and structures of flotation plants for wastewater purification and sediment treatment, attention should be paid to the following aspects: increase in operating efficiency of devices for dissolving air and gas in liquid; providing optimum conditions of flotation separation of gas and liquid medium; studying hydrodynamic conditions of frother cells; studying physical and chemical properties of water air medium; creating reagents for floation treatment of wastewater and compaction of sediments and activated sludges; studying flotation process accompanied by sorption, adsorption, and oxidation; designing combined installations; studying the pecularities of flotation treatment of wastewater and final treatment of biologically purified water with activated sludge compaction; designing devices for froth removal, its processing and reclaiming of valuable components; designing automatized flotation plants; and generalizing the operational results of flotation plants and their technical and economic evaluation. (Baker-IVI)
W86-01736

CURRENT STATUS OF DENVER'S POTABLE WATER REUSE PROJECT,
Denver Water Dept., CO.
For primary bibliographic entry see Field 3B.
W86-01742

RECLAIMING DESERT LANDS THROUGH WATER REUSE,
Goff Consulting and Engineering Corp., Chandler, AZ.
J. D. Goff, and P. L. Busch.
Journal of American Water Works Association, p. 84-87, July, 1985. 1 Fig, 4 Tab.

Descriptors: *Water reuse, *Land reclamation, Deserts, Urban areas, Municipal wastewater, Wastewater treatment facilities, Urban areas, Chandler, Arizona.

The city of Chandler, Arizona, has implemented a program for total reuse of its municipal wastewater effluent. The municipal water system is supplied from groundwater sources that are being pumped at a rate far in excess of the rate of recharge. To meet the total future water supply needs, reuse of municipal wastewater is essential. A new reclamation facility will serve as the cornerstone of the city's program, which has several unique aspects. The new wastewater treatment facility will be sited where there is no adjacent watercourse, thus necessitating complete reuse of its effluent. Financing, ownership, and operation of the facility are being done through privatization. The reuse system has been developed through a public-private partnership between the city and landowners whose property borders the facility. The facilities will include an effluent pipeline and an artificial lake system, to be surrounded by a golf course, greenbelt area, and areas designated for residential and commericial development. (Moore-IVI)
W86-01746

BACTERIAL ADHESION AND FOULING OF REVERSE OSMOSIS MEMBRANES,
Orange County Water District, Fountain Valley, CA. Water Factory 21.
H. F. Ridgway, M. G. Rigby, and D. G. Argo.
Journal of the American Water Works Association, p 97-106, July, 1985. 16 Fig, 36 Ref.

Descriptors: *Wastewater renovation, *Reverse osmosis, *Membrane processes, *Bacteria, Biofouling, Mycobacterium, Escherichia, Acinetobacter, Cellulose acetate, Hydrophobic interaction.

Adhesion of selected bacteria to cellulose actetate (CA) reverse osmosis (RO) membranes used in wastewater reclamation processes was investigated to determine its role in membrane fouling and reduces process efficiency. Adhesion of a Mycobacterium sp. previously isolated from an early stage of RO membrane biofouling was relatively unaffected by large variations in the ionic strength or pH of the buffer system. However, trace quantities of a polyoxyethylene ether nonionic detergent almost completely inhibited attachment. The mycobacteria were found to adhere to the CA membrane surface (or to a CA-affinity column) approximately 25-fold more effectively than a wild-type strain of Escherichia coli. The ability of Mycobacterium and E. coli to adhere to the membrane was correlated with their relative surface hydrophobicities as determined by their affinities for n-hexadecane. A similar correlation was established between a hydrophilic wild-type strain of Acinetobacter phosphadevorus containing a single 17.8 mega-Dalton plasmid (PYG1) and a more hydrophobic isogenic derivative strain (P7P-) lacking the PYG1 plasmid. Unlike the P7WT parent strain, the P7P- derivative produced more fimbrialike appendages, which may account for its enhanced hydrophobic and adhesive properties. The results suggest that hydrophobic interactions between bacterial cell surface components and the CA membrane surface play an important role in the initial stages of bacterial adhesion and RO membrane biofilm formation. (Author's abstract)
W86-01748

EFFECTS OF SEWAGE EFFLUENT ON ENDOMYCORRHIZAL DEVELOPMENT IN ACER,
Michigan Univ., Ann Arbor. School of Natural Resources.
P. C. Otto, and J. R. Boyle.
Canadian Journal of Forest Research, Vol. 14, No. 2, p 246-249, April, 1984. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Wastewater irrigation, *Maple trees, *Endomycorrhizae, Phosphorus removal, Nitrogen removal, Wastewater renovation, Forests, Michigan.

Application of stabilized sewage effluent on forested sites has proved an effective means of removing phosphorus and nitrogen which could otherwise cause overabundant growth in lakes and streams. The effects of such applications on mycorrhizal association must be included in a complete evaluation of the effects of sewage effluent application to hardwood forest sites. Secondarily treated sewage effluent was sprayed into a 50-year-old beech-maple forest near Harbor Springs, Emmet County, Michigan. Effluent was applied at rates of 0, 3.8, and 7.6 cm per week onto thinned and unthinned plots during the growing seasons of 1978 and 1979. Each spray rate and density combination was replicated four times. Acer sp. roots were examined each growing season to evaluate development of endomycorrhizae. Numbers of mycorrhizae were significantly greater in the sprayed than in the unsprayed plots but did not vary significantly with month of thinning. Nutrient additions and increased water availability may have contributed to the mycorrhizal increases at this site. The endomycorrhizal increases observed on this study site further indicate the suitability of these hardwood sites for use in wastewater renovation. (Moore-IVI)
W86-01778

CALCULATION OF OXYGEN CONSUMPTION AND AMOUNT OF EXCESS ACTIVATED SLUDGE IN MULTISTAGE AERATION TANKS,
Kievskii Tekhnologicheskii Inst. Pischevoi Promyshlennosti (USSR).
S. P. Tsygankov.
Water Resources, Vol. 11, No. 4, p 386-390, July-August, 1984. 1 Fig, 1 Tab, 9 Ref. Translated from Vodnye Resursy, No. 4, p 139-143, July-August, 1984.

Descriptors: *Biological wastewater treatment, *Activated sludge process, *Oxygen consumption, *Aeration tanks, Sludge, Mathematical equations, Energy, Wastewater treatment.

Taking into account the energy consumption of the process of biological treatment, which increases with increasing pollution of wastewaters, it is quite important to select the most economical multistage systems. Economy is determined mainly by oxygen consumption and the amount of activated sludge formed, the utilization of which requires certain expenditures. Methods of calculation are developed which are suitable for optimization of sectional or multistage aeration tanks with respect to oxygen expenditures and formation of excess activated sludge. A schematic diagram is presented of the flows of the aeration tank-mixer and secondary sedimentation tank. The conventional assumptions are introduced that processes of an increase of biomass and utilization of the substrate do not occur in the sedimentation tank and there is no activated sludge biomass in the clarified liquid leaving the sedimentation tank. Despite the smaller consumption of the substrate in the second stage, the oxygen requirement is higher owing to oxidation of the incoming activated sludge biomass. The specific consumption of oxygen for treatment increases with decrease of the specific rate of increase of biomass. The latter depends on the flow rate of the biomass entering the aeration tank from the secondary sedimentation tank or from the preceding aeration tank. The specific oxygen consumption and productivity of the aeration tank with respect to biomass are inversely related. The equation obtained can be used for optimization calculations of the stoichiometry of single- and multistage aeration tanks. (Baker-IVI)
W86-01814

ROLE OF MACROPHYTES IN REMOVING ALIPHATIC AMINES FROM WATER,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
S. S. Timofeeva, and O. A. Men'shikova.
Water Resources, Vol. 11, No. 3, p 240-244, May-June, 1984. 4 Fig, 10 Ref. Translated from Vodnye Resursy, No. 3, p 109-113, May-June, 1984.

Descriptors: *Water treatment, *Macrophytes, *Methylamine, Aliphatic hydrocarbons, Organic matter, Aquatic plants, Waterweed, Biological wastewater treatment.

The elimination of methylamine from water by a number of macrophytes and possible mechanisms of this process were investigated, and the possible use of macrophytes in wastewater treatment is discussed. Of the various macrophytes investigated, waterweed had the the maximum rate of elimination of methylamine. While it was not possible to make unequivocal conclusions about the mechanism of the elimination process, both the following components most likely made a substantial contribution to the methylamine elimination process: the diffusion entry and accumulation and enzymatic conversion with the participation both of oxidizing enzymes and other enzymes participating in nitrogen metabolism of plants. Waterweed effectively eliminated methylamine, and methylanime was not detected after 2 days following treatment. The successive introduction of methylamine once a week showed that a waterweed biofilter can actively purify water during the entire time of this study, up to 2 months. When the phytomass of waterweed increases, it is necessary to remove it and keep it within the optimal conditions of 5 g/liter. Waterweed can remove aliphatic amines not only of technogenic origin but also those which are formed upon decomposition of phytoplankton and naturally makes a substantial contribution to self-purificaton of water bodies and to water quality. (Baker-IVI)
W86-01823

USE OF MACROPHYTES FOR TREATING AGRICULTURAL RUNOFF,
N. V. Morozov.
Water Resources, Vol. 11, No. 3, p 259-268, May-June, 1984. 3 Fig, 6 Tab, 39 Ref. Translated from Vodnye Resursy, No. 3, p 131-141, May-June, 1984.

Descriptors: *Macrophytes, *Wastewater treatment, *Agricultural runoff, Biological wastewater treatment, Runoff, Agricultural chemicals, Fertilizers, Farming, Aquatic plants.

Measures aimed at protecting waters from surface runoff from cultivated land can be divided into three groups. The first calls for improvement of farming practices. The second includes measures to prevent the inflow of polluted surface and drainage runoff by diverting it into lagoons, stabilization and oxidation ponds, buffer reservoirs, or other holding areas. The third group is aimed at the accumulation and decontamination of the diffuse surface runoff. Biological ponds with their photosynthetic aeration by microalgae and higher aquatic plants have potential application for decontaminating surface waters. The considerable filtering, accumulating, absorbing, and mineralizing ability of macrophytes makes them a powerful factor for biological self-purification of fresh and brackish waters. Duckweed showed maximum activity in extracting nitrate and nitrite nitrogen from the water. The ability of macrophytes to remove fertilizers from water improves in June and July, which is related to the period of active physiological activity of the plants. In these months the content of nitrite nitrogen in experiments with bulrush and cattail decreased by more than tenfold as early as five days after fertilizer application. Experiments with bulrush, narrowleaf cattail, and waterweed showed that waterweed extracts nitrates more than nitrites from wastewaters. The use of higher aquatic plants for treating highly eutrophic waters can be accomplished by introducing them in the littoral zones and mouths of small rivers, in shallows of reservoirs, or in canals, buffer storages, biological ponds or lagoons, specially created for this purpose. (Baker-IVI)
W86-01826

STOICHIOMETRY OF PROCESSES OF AEROBIC BIOCHEMICAL WASTEWATER TREATMENT,
Ministerstvo Sel'skogo Khozyaistva URSR, Kiev. Main Design Inst.
S. P. Tsygankov, O. P. Smirnov, A. N. Dergileva, and T. P. Slyusarenko.
Water Resources, Vol. 11, No. 3, p 268-272, May-June, 1984. 4 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No. 3, p 142-146, May-June, 1984.

Descriptors: *Wastewater treatment, *Activated sludge process, *Evaluation, *Stochastic process, Aerobic digestion, Mathematical equations, Carbon dioxide, Oxygen, Carbon.

The relationship between the technological parameters of a treatment process and material and energy balance in apparatus consisting of a biochemical reactor (mixer) and biomass sedimentation tank was investigated. The balance of elements was studied during continuous culturing of activated sludge microorganisms on wastewaters of a swine-raising complex in the ANKUM-2 apparatus at a temperature of 20 degrees C. The working volume of the fermenter was 1 and 2 liters, the rotational speed of the stirrer was 500/min with complete oxygen saturation of the fluid. Culturing was carried out at various dilution rates: 0.16, 0.04, and 0.02/hr. The fermenter was connected with the sedimentation tank by a 1 liter vessel, for withdrawing the excess and recirculating biomass for which a peristaltic pump was used. Equations are derived which can be used for evaluating aerobic wastewater treatment systems. (Baker-IVI)
W86-01827

INFLUENCE OF NITRATES ON BIOLOGICAL PHOSPHORUS REMOVAL FROM WASTEWATER,
Compagnie Generale des Eaux, Paris (France). Anjou Recherche.
M. C. Hascoet, and M. Florentz.
Water S. A., Vol. 11, No. 1, p 1-8, January, 1985. 7 Fig, 4 Tab, 13 Ref.

Descriptors: *Nitrates, *Phosphorus removal, *Biological wastewater treatment, Aeration, Nuclear magnetic resonance, Aerobic conditions, Anaerobic conditions, Biomass.

A study was carried out to observe the behavior of orthophosphates under aerated or non-aerated conditions in the presence of nitrates during batch experiments, the effect of nitrate concentration (40 mg/l as N) in the influent of a laboratory unit prior to phosphate removal and the evolution of phosphorus assimilation after stopping nitrate addition. Phosphorus nuclear magnetic resonance was used to observed the changes in the different phosphorus compounds with time, without disturbing the living system. The substrate concentration expressed as COD must be taken into account as well as the concentration of nitrates being introduced in the anaerobic zone. Nitrates, even in high concentrations during the aerobic stage do not prevent good phosphorus uptake by microorganisms, although they can prevent the formation of an anaerobic phase required for the luxury uptake of phosphorus. The polyphosphates are not used during the non-aerated period because the ATP pool can be maintained by the glycolitic metabolism. The continuous addition of nitrates during the non-aerated phase modified either the microbial population or the enzymatic activities, because the release of phosphate is not immediate after stopping the nitrate addition to the feed, but takes seven days to occur. This time is necessary to acclimatize the biomass to the alternating anaerobic-aerobic phases. (Moore-IVI)
W86-01857

KINETICS AND MECHANISM OF OZONATION OF FREE CYANIDE SPECIES IN WATER,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
M. D. Gurol, and W. M. Bremen.
Environmental Science and Technology, Vol. 19, No. 9, p 804-809, 1985. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Chemical kinetics, *Ozonation, *Cyanides, Ozone, Hydrogen ion concentration, Cyanates, Wastewater treatment, Mass transfer.

The kinetics and the mechanism of the ozonation reaction of free cyanide species were investigated in aqueous solution in the pH range 2.5-12.0. According to the kinetic results obtained with a stopped-flow spectrophotometer, the reaction is first order with respect to ozone, and the rate increases with increasing pH. The rate shows a varying dependence on cyanide concentration for different pH values. The rate constant for the direct reaction of molecular ozone with cyanide ion was calculated to be 2600 +/- 700/M/s. Batch and bubble-column experiments indicated stoichiometric conversion of cyanide to cyanate and an ozone consumption of 1.2 +/- 0.2 mol/mol of oxidized cyanide. Ozonation of cyanide-bearing wastewaters at high pH is expected to be mass transfer limited under the operating conditions of most experimental or full-scale contactors. The kinetic regime for the process at neutral pH should depend upon the mass-transfer characteristics of the ozone contactors. (Moore-IVI)
W86-01870

LOW-TECH SCORES PAR FOR WATERING GOLF COURSE,
Greeley and Hansen Southwest, Phoenix, AZ.
W. A. Ambrose.
Consulting Engineer, Vol. 65, No. 3, p 38-39, September, 1985. 1 Fig.

Descriptors: *Wastewater treatment, *Golf courses, *Water reuse, Irrigation water, Design criteria, Water supply development.

Innovative application of basic water reclamation tenets provided the solution for irrigating the 27 hole championship golf course that is part of Gainey Ranch, a 640 acre, luxury, mixed use resort community under development. There is adequate groundwater on site for irrigation. For other purposes, a 1.7 mgd water reclamation plant was included as part of the initial design phase of the development. The objectionable characteristics of odor, noise, and unsightliness were overcome by specific design adaptations. Public acceptance has been achieved in direct relationship to the success of these design adaptations. Wastewater flows in a serpentine fashion through five 20 ft by 116 ft aeration tanks. Next, it flows to two 20 ft x 100 ft rectangular clarifiers where sludge and dilute scum are collected. The dilute scum flows by gravity and waste sludge is pumped back to the municipal sewer. Clarified water flows to two 9 x 38 ft rapid sand filters and then to two ultraviolet disinfection units before it is pumped to the reclaimed water reservoir. From there it subsequently is pumped for lake level maintenance and golf course irrigation. Environmental controls for the plant are briefly considered. (Baker-IVI)
W86-01881

SORPTION OF CARBON AND PHOSPHORUS FROM LIQUID POULTRY MANURE BY SOIL AGGREGATES OF DIFFERING SIZE,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
V. K. Bhatnagar, and M. H. Miller.
Canadian Journal of Soil Science, Vol. 65, p 467-473, August, 1985. 7 Tab, 12 Ref.

Descriptors: *Carbon, *Phosphorus, *Manure, *Soil aggregates, *Sorption, Particle size, Animal wastes, Wastewater disposal, Particulate matter.

A series of laboratory experiments was conducted to determine the mechanism(s) responsible for a previously reported observation that addition of liquid manure to soil increased the NaHCO3-extractable P (Ext-P) of large aggregates (>2 mm) more than that of smaller aggregates whereas addition of an inorganic P solution did not. Application of liquid poultry manure increased the total P, Ext-P and total C concentrations in large aggregates (> 2mm) much more (> 2.5x) than that in small aggregates (< 1 mm). Addition of inorganic P solution or of supernatant liquid from a centrifuged manure slurry increased the P content of the large aggregates only slightly (1.2x). A greater increase in Ext-P in large aggregates was observed even when the smaller aggregates were purposely layered on top of the larger ones prior to addition of the liquid manure. A similar but less pronounced effect of aggregate size on increase in P or C concentration was observed when different sized aggregates were left in contact with an effectively infinite source of liquid manure for 24 h. It is concluded that the larger aggregates absorbed more of the bulk manure slurry than smaller aggregates. A partial sealing of small aggregates by particulates is suggested as a possible mechanism. (Author's abstract)
W86-01908

5E. Ultimate Disposal Of Wastes

APPLICATION OF ARTIFICIAL CLAYS IN THE CONTROL OF TOXIC POLLUTANTS,
Chemfix International Ltd., London (England).
P. J. D. Jarrett, and E. W. Marwood.
Engineering Geology, Vol. 21, No. 3/4, p 267-272, June, 1985. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Hazardous materials, *Landfills, *Artificial clay, *Waste disposal, Water pollution prevention, Sodium silicate, Cement, Waste stabilization, Heavy metals, Sludge disposal.

The potential for acid leaching is one of the major causes for concern in the landfilling of heavy metal sludges. It is possible to create barriers against migration around the toxic particles themselves, rather than around a landfill as a whole. The CHEMFIX process starts with a concentrated solution of sodium silicate, which is mixed with the waste. This is in turn mixed with cement. In the final mixture, the cement reacts with the evenly distributed silicate to give a gel around the waste particles that creates the desired barriers to migration. The artificial clay-like solid resulting from the stabilization of toxic waste using the CHEMFIX process has many advantages. The CHEMFIX waste-form, because of its low permeability, high buffer capacity against acid leaching and its clay-like structure and properties, can be used to stabilize heavy metal sludges for landfilling. A simple model is developed and used to investigate the values of the various parameters involved in the product design. The immobilization periods expected for a CHEMFIX wasteform monolith are in excess of current design values for screens and liners. (Moore-IVI)
W86-01456

EFFECT OF LEACHING ON THE INTEGRITY OF A NATURAL CLAY,
McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
R. N. Yong, D. S. Elmonayeri, and T. S. Chong.
Engineering Geology, Vol. 21, No. 3/4, p 279-299, June, 1985. 22 Fig, 3 Tab, 17 Ref.

Descriptors: *Leaching, *Clay, *Strength, *Integrity, Liners, Waste ponds, Soil properties, Water pollution prevention, Chemical properties, Boundary conditions, Soil structure.

Clay minerals have long been used as ion-sieving filters, separators, or reinforcing elements to prevent contamination of the domestic groundwater from the transmission of polluted liquids through the bottom and side boundaries of waste holding ponds. Leaching effects on the strength of a natural clay substrate can lead to loss of integrity of pond containment situation, especially if the clay material constitutes the liner system for the containment pond. The integrity of the clay in the face of five different types of leachates is studied via the creep characteristics of the clay. The leachate types include sodium silicate, sodium chloride, sodium acetate, saturated calcium hydroxide solution plus 10 carbon dioxide air, distilled water and a reference natural untreated water sample. The resultant effects are evaluated in terms of soil fabric/structure reinforcement or degradation, and changes in the relationships established between soil particles and chemical pore fluid. The integrity of the clay is severely conditioned by factors producing the initial soil structural state, the chemistry of the leachate, local boundary conditions, and time. (Moore-IVI)
W86-01457

US SLUDGE MANAGEMENT GUIDELINES EXPLAINED,
E. D. Lomnitz.
Water and Water Treatment, Vol. 28, No. 4, p 37, 40, April, 1985.

Descriptors: *Sludge management, *Standards, Management, Planning, Sludge disposal, Wastewater management.

An EPA sludge task force was established in 1982 which was responsible for assessing the magnitude and management approaches to municipal sludge reuse and disposal nationwide, evaluating strengths and weaknesses of past regulatory activities, and identifying data and informational needs in order to direct EPA research in the field. In developing regulations for reuse/disposal options, several key areas need to be considered including the identification of potential pollutants, the magnitude of hazard or risk, levels at which these pollutants cause these risks, the existence of management practices which could reduce the risks, and the relevant risks between the various reuse/disposal options. With the completion of technical support documents, drafting of the proposed regulations can commence. The proposed regulations will clearly delineate the requirements in terms of management practices and numeric standards. The regulations will also contain compliance monitoring requirements. (Baker-IVI)
W86-01461

USE OF AERIAL PHOTOGRAPHY AND IMAGE PROCESSING TO MEASURE DYE DISPERSION FROM A LONG SEA OUTFALL,
Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W86-01518

MANAGEMENT OF CONTAMINATED DREDGED MATERIAL FROM THE HUDSON RIVER,
Pirnie (Malcolm), Inc., White Plains, NY.
For primary bibliographic entry see Field 5G.
W86-01564

EFFECT OF SEWAGE SLUDGE ON MICROBIAL ACTIVITY IN AN OLD, ABANDONED MINESOIL,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
H. F. Stroo, and E. M. Jencks.
Journal of Environmental Quality, Vol. 14, No. 3, p 301-304, July-September, 1985. 3 Tab, 45 Ref. West Virginia University Mining and Mineral Res. Inst. project MI8050R.

Descriptors: *Sludge, *Water pollution effects, *Land reclamation, *Mining, *Minesoils, *Microbial activity, Enzymes, Amylase activity, Phosphatase activity, Respiration, Urease activity, Fescue, Waste disposal, Land treatment.

The effect of lime, fertilizer, and sewage sludge (50 and 100 kg/ha) upon microbial activity and growth of sparsely distributed tall fescue (Festuca arundinaceae Schreb.) on an old, acidic, infertile sandy loam (Typic Udispolents; loamy-skeletal, mixed, acid, mesic) minesoil was evaluated. Respiration rate and activities of amylase, urease, and phosphatase were used as indices of microbial activity. When compared with the control, lime significantly increased respiration rate, had no effect upon amylase and urease activities, and significantly reduced phosphatase activity. Fertilizer significantly increased respiration rate and amylase activity, but significantly decreased urease activity. Phosphatase activity was not affected by fertilizer applications. Lime plus fertilizer significantly increased respiration rate and amylase activity, had no affect upon phosphatase activity, while it drastically reduced urease activity. Sludge at both rates of application in conjuction with lime and fertilizer (S1LF, S2LF) are only compared with the lime-fertilizer treatment. Both S1LF and S2LF significantly increased respiration rate and urease activity; S2LF was significantly more effective more than S1LF. Amylase activity was significantly increased by both S1LF and S2LF, although there was no difference between the two treatments. The S1LF had no effect upon phosphatase activity, whereas activty, whereas S2LF caused a significant activity increase. All treatments produced significant increases in tall fescue yield. Fertilizer was significantly more effective than lime. The fertilizer and the lime-fertilizer treatments were about equally effective. Both S1LF and S2LF produced yields that were significantly greater than the lime-fertilizer treatment. The S2LF had a significantly greater effect upon yield than did S1LF. (Author's abstract)
W86-01702

CONDITIONING OF ANAEROBICALLY DIGESTED SLUDGE,
Camp, Dresser and McKee, Inc., Raleigh, NC.
A. I. Cole, and P. C. Singer.
Journal of Environmental Engineering, Vol. 111, No. 4, p 501-510, August, 1985. 10 Fig, 1 Tab, 6 Ref.

Descriptors: *Anaerobic digestion, *Sludge conditioning, *Polyelectrolytes, Electrolytes, Biological treatment, Digestion, Polymers, Wastewater treatment.

Synthetic organic polyelectrolytes can be used to condition sludges to enhance their dewaterability. When conditioning biological sludges, the charge on the polymer has a significant impact on the effectiveness of the polymer as a conditioner. The objectives of this investigation were to determine the most effective type of polymer product for conditioning anaerobically digested sludge prior to dewatering, and to investigate how the chemical characteristics of the polymer influence the way it interacts with the sludge particles. Capillary suction time and particle electrophoretic mobility measurements were employed to achieve this objective. The results indicate that cationic polymers with molecular weight in excess of 1,000,000 appear to be required for effective conditioning. However, effective sludge conditioning can be achieved with either high or low charge density cationic polymers and that dosing to achieve charge neutralization of the sludge particles is not a prerequisite for effective sludge conditioning. (Author's abstract)
W86-01728

DESIGN CONSIDERATIONS FOR A NOVEL LANDFILL LINER,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W86-01730

5F. Water Treatment and Quality Alteration

FLOCCULATION, PRECIPITATION, SEDIMENTATION AND FLOTATION FOR USE AS PRETREATMENT STAGES FOR BRACKISH WATER AND SEAWATER IN DESALINATION PLANTS,
Hager und Elsaesser G.m.b.H., Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W86-01370

REVERSE OSMOSIS AND ULTRAFILTRATION SOLVE SEPARATION PROBLEMS,
Clemson Univ., SC.
For primary bibliographic entry see Field 5D.
W86-01441

ROLE OF FORMATION AND REDUCTION OF THM AND CHLORITE CONCENTRATIONS IN THE DISINFECTION OF WATER WITH CL2 AND CLO2,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
Ch. Rav-Acha, E. Choshen, A. Serri, and B. Limoni.
Environmental Pollution (Series B), Vol. 10, p 47-60, 1985. 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Disinfection, *Chlorine, *Chlorine dioxide, *Trihalomethanes, *Chlorite, Water treatment, Drinking water, Chlorination, Oxidation, Lake Kinneret, Israel.

Chlorine dioxide is one of the most promising alternatives to chlorine for the disinfection of drinking water. One of the major advantages of chlorine dioxide over chlorine is that it does not produce trihalomethanes (THM); however, chlorine dioxide is reduced mainly to undesirable chlorite. Mixtures of ClO2 and Cl2 may successfully reduce the formation of both THM and chlorite in the absence of bromide. The ClO2 may compete with chlorine for the organic precursors, thus reducing the formation of chlorinated by-products, while the chlorine can, in turn, oxidize the chlorite, which is the main reduction product of chlorine dioxide. When Lake Kinneret water in Israel was studied, however, it was found that such mixtures caused only a minor reduction in the formation of THM compared with chlorine alone. This is probably due to the presence of 2 mg/l bromide in the water of Lake Kinneret. The formation of THM and chlorite may be satisfactorily reduced (by about 60% and 90%, respectively), if chloride dioxide is allowed to react in water with the THM precursors before chlorine is introduced. (Moore-IVI)
W86-01453

WATERBORNE EPIDEMIC OF ACUTE INFECTIOUS NON-BACTERIAL GASTROENTERITIS IN ALBERTA, CANADA,
903 Abbotsford Drive N.E., Calgary, Alberta T2A 5Y3.
For primary bibliographic entry see Field 5C.
W86-01486

IMPROVEMENTS IN TREATMENT PERFORMANCE AT GRAFHAM WATER TREATMENT WORKS: ANGLIAN WATER,
C. Harward.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 225-230, June, 1985. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Water treatment facilities, *Grafham Water Treatment Works, *England, *Water treatment, Coagulation, Aeration, Soda ash, Filtration, Sludge.

The effect of modifying the coagulant aid dosing system and other operational changes which resulted in the achievement of the desired increased efficiency at the Grafham Water Treatment Works are reviewed. During the winter of 1983-84 a prolonged increase in demand for water at a time of low water temperatures (3-6 C) resulted in treatment difficulties when flows exceeded 182 Ml/d. Improved polymer dispersion and increased delay between coagulant and coagulant aid dosing resulted in marked improvement in floc blanket stability and settled water quality. This enabled substantial savings in treatment chemical costs to be made and increased the treatment capacity of the works during the period when water temperatures were low. Changes in filter washing practices combined with improved settled water quality reduced the number of daily filter washes, thereby further reducing costs. (Baker-IVI)
W86-01520

MODELING THE EFFECTS OF HYDROLYZED ALUMINUM AND SOLUTION CHEMISTRY ON FLOCCULATION KINETICS,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman, and D. R. Iyer.
Environmental Science and Technology, Vol. 19, No. 8, p 673-681, August, 1985. 7 Fig, 4 Tab, 29 Ref, 1 Append.

Descriptors: *Flocculation, *Computer models, *Aluminum compounds, Model studies, Coagulation, Solution chemistry, Surface properties, Ionization, Complexation, Particulate matter.

Computer programs are available that allow self-consistent calculations to be made simultaneously for solution and surface chemical equilibria. One of these programs, an augmented version of MINEQL, employs the Gouy-Chapman-Stern-Grahame model of the electrical double layer to account for the distribution of charge and potential at the solid solution interface. In this study the modified program has been used to predict the effects of solution and suspension variables on flocculation efficiency when aluminum salt coagulants are used. Electrophoretic mobility measurements and constant pH titrations with the surface complexing sulfate ion have been used to determine intrinsic surface ionization and complexation constants for the aluminum sites. Expressions that relate the model-predicted electrical double-layer characteristics of the aluminum-treated particles and the amount of aluminum hydroxide coating on the particles to the efficiency of flocculation are also employed. For the simple system tested, model predictions of relative flocculation efficiency are in reasonable agreement with batch flocculation results. (Author's abstract)
W86-01617

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER - III; INORGANIC COMPOUNDS AND RADICALS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2K.
W86-01641

ADSORPTION OF HUMIC ACIDS ONTO POWDERED ACTIVATED CARBON; THE INFLUENCE OF SODIUM TRIPHOSPHATE (ADSORPTION DES ACIDES HUMIQUES SUR CHARBON ACTIVE EN POUDRE INFLUENCE DU TRIPHOSPHATE DE SODIUM),
Limoges Univ. (France). Lab. de Genie Chimique, Traitement des Eaux.
P. Lafrance, and M. Mazet.
Water Research, Vol. 19, No. 8, p 1059-1064, 1985. 6 Fig, 20 Ref.

Descriptors: *Adsorption, *Humic acids, *Activated carbon, *Sodium triphosphate, Water treatment, Detergents, Fulvic acids, Electrokinetics, Hydrogen ion concentration, Phosphates.

The removal of natural humic and fulvic substances found in water supplies, through the use of activated carbon beds is under study. The effect of a main component of domestic detergents, sodium triphosphate (STP), on the adsorptive capacities of powdered activated carbon (PAC) for commercially supplied humic acids was determined at different pH values in distilled water. A first batch equilibrium study showed an effective enhancement of adsorption capacity for humic acids as a function of STP concentration in a non buffered media (pH of distilled water, close to 5.0). Visible absorption analysis of humic acids indicates an increase of 93% (500 mg/l PAC) and 133% (1000 mg/l PAC) in the carbon adsorption efficiency for a STP concentration from 0.2 to 1.0 mM. A second batch equilibrium study led to adsorption isotherms for humic acids in distilled water, as a function of STP concentration and initial pH value of the non-buffered multicomponent system. Freundlich isotherms showed an increase in the adsorption capacity of the PAC for humic acids, with a decrease in pH and an increase in STP concentration. The adsorption capacity for humic acids is reduced at high pH values in the presence of STP, in comparison with results obtained with distilled water. Electrokinetic measurements of PAC suspensions indicates that both humic acids and STP induce a negative variation of the zeta potential of carbon particles. In such a binary system, the zeta potential is a linear function of the pH; the negative surface charge of the carbon increasing with an elevation of pH. Some adsorption of triphosphate polyanion from solution could occur, contributing to the apparent negative surface charge of PAC particles. (Moore-IVI)
W86-01649

REMOVAL OF RADON FROM WATER SUPPLIES,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry, and J. E. Brandow.
Journal of Environmental Engineering, Vol. 111, No. 4, p 511-527, August, 1985. 13 Fig, 2 Tab, 36 Ref. U.S. EPA grant R808724.

Descriptors: *Radon, *Water treatment, *Water pollution, Activated carbon, Adsorbants, Geochemistry, Water supply, Groundwater.

Granular activated carbon (GAC) adsorption is extremely effective for the removal of radon from water supplies. A high removal efficiency is achieved through an adsorption/decay steady state that can result in near-background radon levels with currently available commercial GAC units. An adsorption/decay steady state analysis based upon secular equilibrium shows that the life of the GAC will be in terms of decades with respect to radon. A variety of GAC products were evaluated for radon removal and laboratory and field data are presented to document the steady state performance for water supplies ranging in concentration from 1,500-750,000 pCi/L. Because radon and its daughters build to steady state levels corresponding to the influent mass loading, the GAC bed becomes a source of low gamma radiation. An

empirical relationship is presented to estimate the maximum activity of the bed as a function of the influent radon concentration. This relation and other field measurements show that the low level activity of GAC bed does not present a problem for the vast majority of high radon wells. (Author's abstract)
W86-01729

PROTECTIVE COATINGS FOR WATER STORAGE TANKS AND WATER TREATMENT FACILITIES,
Mobil Chemical Co., Edison, NJ.
For primary bibliographic entry see Field 8G.
W86-01753

DIMETHYL TRISULPHIDE AND OBJECTIONABLE ODOURS IN POTABLE WATER,
Western Australian Inst. of Tech., South Bentley. School of Applied Chemistry.
J. E. Wajon, R. Alexander, and R. I. Kagi.
Chemosphere, Vol. 14, No. 1, p 85-89, 1985. 2 Fig, 16 Ref.

Descriptors: *Odor, *Potable water, *Dimethyl trisulfide, Perth, Western Australia, Sulfur compounds, Water conveyance.

Intermittently in the past five years, some residents of part of the metropolitan area north of Perth, Western Australia, experienced unpleasant odors in their water supply. These odors were described as swampy, sulfidic or like cooked vegetables. The odor episodes were often ephemeral and extremely localized in occurrence. The swampy odor was only present in water samples taken from the water supply mains or residences. Dimethyl trisulfide was found in samples of potable water in concentrations ranging from 5 to 250 ng/l. The presence of dimethyl trisulfide in concentrations greater than 10 ng/l was associated with the objectionable odor in water samples. The odor intensity and dimethyl trisulfide concentrations increased in distribution mains with increasing distance from a holding reservoir. The mechanism of formation of dimethyl trisulfide in the water supply is not yet known. (Moore-IVI)
W86-01851

TOXICITY AND MUTAGENICITY EVALUATION OF WATER COAGULATED WITH MORINGA OLEIFERA SEED PREPARATIONS USING FISH, PROTOZOAN, BACTERIAL, COLIPHAGE, ENZYME AND AMES SALMONELLA ASSAYS,
National Inst. for Water Research, Pretoria (South Africa).
W. Grabow, J. L. Slabbert, W. S. G. Morgan, and S. A. A. Jahn.
Water S. A., Vol. 11, No. 1, p 9-14, January, 1985. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Toxicity, *Mutagenicity, *Coagulants, *Moringa, *Water treatment, Fish, Protozoa, Bacteria, Enzyme inhibition, Fish behavior, Toxins, Glycosides.

Moringa oleifera seed preparations equivalent to the 200 mg/l of cotyledon powder generally used for the coagulation of drinking-water in some rural areas had toxic effects on fish (guppies) (Poecilia reticulata), protozoa (Tetrahymena pyriformis), bacteria (Escherichia coli) and inhibited the enzyme acetylcholinesterase. The preparations had no effect on coliphages or the enzymes lactic dehydrogenase or invertase, nor did they display mutagenic effects in Ames Salmonella mutagenicity assays. Concentrations as low as the equivalent of 5 mg/l cotyledon powder affected the oxygen uptake rate of T. pyriformis, 30 to 40 mg/l induced aberration in locomotor behavior patterns of guppies, while the 96-h LC50 for guppies was 196 mg/l. Salmonella mutagenicity assays yielded negative results for batch and serial extracts representing the equivalent of up to 1,000 mg/l cotyledon powder. Toxicity was limited to seed cotyledons; pericarps (shells) had no effect. The results suggest that toxic effects were due to the antimicrobial constituent 4(alpha-L-rhamnosyloxy) benzyl isothiocyanate, a glycosidic mustard oil. In view of complex associations of the toxin with organic matter, instability and the mechanism of action, it would, however, not appear to constitute a human health risk, at least not in the concentrations generally involved in the utilization of the seeds for nutritional, medicinal or water purification purposes. (Author's abstract)
W86-01858

EVALUATION OF THE ACTIVATED ALUMINA PROCESS FOR FLUORIDE REMOVAL FROM DRINKING-WATER AND SOME FACTORS INFLUENCING ITS PERFORMANCE,
National Inst. for Water Research, Pretoria (South Africa).
J. J. Schoeman, and G. R. Botha.
Water S. A., Vol. 11, No. 1, p 25-32, January, 1985. 5 Fig, 4 Tab, 23 Ref.

Descriptors: *Water treatment, *Fluoride removal, *Drinking water, *Activated alumina, Caustic soda, Alum, Hydrogen ion concentration, Design criteria, Costs.

The activated alumina defluoridation process was evaluated on an underground mine water containing approximately 8 mg/l of fluoride. The objectives of the study were to compare regeneration methods (caustic soda vs. aluminium sulfate (alum)), determine the importance of feedwater pH adjustment (pH 5 to 6) on process performance, establish design criteria for a 518 cu m/d plant. and to determine the economics of the process. Fluoride could be reduced from approximately 8 to less than 1 mg/l. Approximately one and a half times as much product water of a better quality could be produced with caustic soda than with alum as regenerant. Silicate and hydroxyl ions appeared to compete more strongly with fluoride ions for exchange sites when the pH of the feed was greater than 7. This resulted in a much reduced capacity for fluoride removal. The operating fluoride exchange capacity for design purposes was determined at 3.2 g/l alumina and the total defluoridation costs for a 518 cu m/d plant were calculated at R 0.33/cu m of treated water. (Author's abstract)
W86-01859

TRANSFER OF ACTIVE CHLORINE FROM CHLORAMINE TO NITROGENOUS ORGANIC COMPOUNDS. 2. MECHANISM,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
R. A. Isaac, and J. C. Morris.
Environmental Science and Technology, Vol. 19, No. 9, p 810-814, 1985. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Chloramine, *Nitrogen compounds, *Chlorination, Organic compounds, Hydrolysis, Chemical reactions, Chemical kinetics.

In the kinetics of Cl(+) (i.e., active chlorine) transfer from NH2Cl (chloramine) to nitrogenous organic compounds, there are two plausible pathways: hydrolysis, and direct transfer. Transfer of active chlorine from NH2Cl to nitrogenous organic compounds occurs by direct transfer as well as by hydrolysis of NH2Cl which forms HOCl which then can react with the nitrogenous substrates. The nitrogenous compounds investigated fall into two categories: those that form zwitterions and anions and those that form primarily neutral and positive species. In this study, direct transfer was the dominant pathway and involved a second-order reaction - first order in NH2Cl and the nitrogenous substrate. At least two plausible mechanisms can explain the observed data, and a reasonable correlation exists between the absolute rate constants and the basicity of the nitrogenous receptor. Either hydrolysis of NH2Cl or direct transfer of Cl(+) can be the primary pathway depending on the concentrations of the reactants. (Moore-IVI)
W86-01871

HIGH-TECH SOLUTION TO CONTAMINATED DRINKING WATER,
Pirnie (Malcolm), Inc., White Plains, NY.
G. P. Westerhoff, and R. Miller.
Consulting Engineer, Vol. 65, No. 3, p 34-37, September, 1985. 2 Fig.

Descriptors: *Granular activated carbon, *Organic compounds, *Drinking water, *Water treatment, Water treatment facilities, Design criteria, Adsorption, Cincinnati, Ohio.

The nation's first large-scale facility using granular activated carbon is being built to remove a broad spectrum of organic contaminants from the city's drinking water in Cincinnati, Ohio. Cincinnati draws raw water for its California Water Treatment Plant from the Ohio River. The California Water Treatment plant is a typical alum coagulation/rapid sand filter type plant, with flow going from the filters to two large clear wells prior to distribution. A pilot study, conducted in 1977, had as its primary objective the determination of whether GAC was a feasible method for removing trace organics from water while treating it for use as drinking water. While the use of GAC is not new in the US, it has been largely limited to taste and odor control in potable water system filter beds, polishing in wastewater reclamation operations, and in certain industrial processes. Integrating the design of the 175 mgd facility into an existing treatment plant was a challenging task. Special design features and construction features are described. (Baker-IVI)
W86-01880

PRACTICAL, LOW-TECH PLANT ASSURES SUPPLY TO 2010,
Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, and A. H. Adams.
Consulting Engineer, Vol. 65, No. 3, p 40-43, September, 1985. 1 Table.

Descriptors: *Water treatment, *Water treatment facilities, *Drinking water, Design criteria, Filtration, Disinfection, Potomac River, Fairfax, Virginia.

The James J. Corbalis Water Treatment Plant, in operation in Fairfax, Virginia, is the first step in a program of capital imporvements that will provide adequate and economical water service for the area into the 21st century. This is the first facility in Virginia to use the Potomac River as a source of water supply. These facilities are a principal element of a water supply program now being developed by area water utilities to avert future shortages during periods of drought through coordinated management of available water resources. The plant is a conventional high rate treatment facility that includes the following processes: rapid mixing, flocculations, sedimentation, filtration, fluoridation, and disinfection; finished water storage and pumping; backwash water reclamation; and solids dewatering by plate and frame filter presses. (Baker-IVI)
W86-01882

HETEROTROPHIC BACTERIA IN WATER DISTRIBUTION SYSTEMS. I. SPATIAL AND TEMPORAL VARIATION,
Centre des Sciences de l'Environment, Metz (France).
A. Maul, A. H. El-Shaarawi, and J. C. Block.
Science of the Total Environment, Vol. 44, p 201-214, 1985. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Heterotrophic bacteria, *Water conveyance, *Spatial distribution, *Temporal distribution, Drinking water, Bacteria, Water distribution, Metz, France, Chlorine, Water mains, Retention time, Water temperature.

The drinking water distribution system of the city of Metz in France was sampled intensively during six monthly surveys which were designed to determine the spatial and temporal distribution of total heterotrophic bacteria in the network. A non-hierarchical nearest-centroid clustering method was used for dividing the water distribution system into zones corresponding to different levels of bacterial density. The general pattern of the spatial heterogeneity showed a high degree of reproducibility. Since the frequency distribution of total heterotrophic bacteria within the zones was compatible with

the negative binomial distribution, the water distribution system studied may be considered as being composed of several heterogeneous subsystems. The consistency of this structured spatial dispersion pattern of bacteria in light of some physical and chemical characteristics of the system is evident. In consideration of the principal features of flow in the system relevant to the layout of water mains, the location of zones of highest bacterial concentrations have been attributed to lower levels of chlorine residuals and prolonged retention time of the water in the network, especially in the storage units, before reaching the various distribution areas. Although the monthly variation in the bacterial concentration of the entire system showed a marked increase which was concomitant with warmest water temperatures, the zones were subject to noticeable discrepancies in the range of temporal variation. (Author's abstract)
W86-01914

HETEROTROPHIC BACTERIA IN WATER DISTRIBUTION SYSTEMS. II. SAMPLING DESIGN FOR MONITORING,
Centre des Sciences de l'Environment, Metz (France).
A. Maul, A. H. El-Shaarawi, and J. C. Block.
Science of the Total Environment, Vol. 44, p 215-224, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Water quality control, *Monitoring, *Bacteria, *Water conveyance, Drinking water, Water quality, Variability, Sampling.

Information on the spatial and temporal variability of bacteriological data from a water distribution system is used to develop a sampling design for use in future water quality monitoring. The water distribution system is considered to be composed of several zones where the variation of bacterial counts in each zone is modelled by the negative binomial distribution. Under the assumption that the objective of monitoring is to determine whether or not the mean bacterial density of the water exceeds a specific standard, a criterion is given which determines the optimal number of sampling stations allocated to each zone. These stations are determined by assuming that either the risk of sampling is prespecified or that the total number of stations to be sampled is predetermined. Sequential sampling offers another way of monitoring the level of bacterial density in a system. The procedure takes into account the concentration of bacteria in the samples after each collection. (Baker-IVI)
W86-01915

5G. Water Quality Control

APPROACH TO THE RESTORATION OF AQUATIC VEGETATION IN THE XIHU LAKE OF HANGZHOU, WITH REFERENCE TO THE WATER QUALITY PROBLEM (IN CHINESE),
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
C. Hongda.
Acta Hydrobiologica Sinica, Vol. 8, No. 2, p 237-244, May, 1984. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Lakes, *Xihu Lake, *Hangzhou, *China, *Water quality, *Aquatic vegetation, Phytoplankton, Fish, Lake management, Nutrients, Nitrogen, Phosphorus, Light penetration, Oysters, Mollusks.

The reasons for the deterioration of aquatic vegetation in Xihu Lake were analyzed and the possibility of, and approach to, restoration of the vegetation was investigated with reference to the water quality problem. There were three main causes for the deterioration: the overstocking of plant-eating fish such as Ctenopharyngoden idellus and Megalobrama amblycephala, the rapid growth of phytoplankton, and the deepening of the lake due to artificial removal of sand. Excessive numbers of plant-eating fish destroyed the vegetation by grazing on it. Due to pollution, the water contained large amounts of nitrogen and phosporous. These nutrients, in turn, were taken in by the phytoplankton, causing a rapid increase of these plants. The excessive phytoplankton deprived the underwater plants of their sun energy by blocking the amount of light penetrating the water. Finally, the deepening of the lake could cause a problem by lowering the light intensity at each and different depths. The situation could be remedied by lowering the water level of the lake, thus permitting more light thru; by limiting the number of plant-eating fish; and by planting new vegetation, using both natural and artificial means. After the vegetation was restored, it might prove to be effective in the removal of nitrogen and phosphorous, thus depriving the phytoplankton of their nutrient sources and curbing their growth. A decrease of these plants would allow higher light intensity to reach all levels of water. Study of using aquatic vegetation in purifying water in lakes had never carried out in this country. But yet, as a way of gaining experience, it was highly recommended that such a project should be started hand in hand with the restoration of the vegetation in Xihu Lake. In order to reduce the amount of nitrogen, phosphorous, and phytoplanktons, the stocking of plant-eating fish should be strictly controlled. If it were possible, the types of fish should be chosen in such a way that they mainly graze on the phytoplankton and organic debris. Furthermore, oysters and mollusks should be protected because they also helped to reduce the amount of organic debris and phytoplankton. (Eng-IVI)
W86-01324

ESTIMATING THE EXTENT OF REDUCTION NEEDED TO STATISTICALLY DEMONSTRATE REDUCED NON-POINT PHOSPHORUS LOADING TO LAKE ERIE,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
R. P. Richards.
Journal of Great Lakes Research, Vol. 11, NO. 2, p 110-116, 1985. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Great Lakes, *Lake Erie, *Eutrophication, *Phosphorus, Nonpoint pollution sources, Land management, Monitoring, Water pollution control, Statistical methods, Pollution load.

A method is presented for estimating the amount of change needed to establish a statistically significant reduction, based on the standard t-test, to nonpoint phosphorus loading in Lake Erie. Analysis of data from the Sandusky River, a north-central Ohio tributary of Lake Erie, indicates that the necessary change is about 35% of the current loads. Assuming that implementation rates will decrease with time, the time spans needed to achieve these changes will differ even more dramatically. Based on projections of implementation rates, a 20% change would require 8 years, but a 35% change would take at least 25 years. Even in cases where best management practices might produce sufficient load reductions for the change to be documented statistically without adjusting the load data for discharge, doing so will allow the change to be documented earlier in the implementation period, and to be more certainly attributed to the best management practices, rather than some other cause. Success in demonstrating a reduction in loads is assisted by a monitoring program which provides sufficient data to calculate loads accurately. Where such programs have been in place long enough to provide a historical database, high priority should be placed on continuing the intensive monitoring effort without change. Otherwise, the changes in sampling strategy will introduce unknown errors and biases into the comparison. This could prevent a real change in loads from being detected statistically, or produce a serious but statistically significant difference where no change in loads had occurred. (Baker-IVI)
W86-01343

LAKE ERIE NUTRIENT LOADS, 1970-1980,
Corps of Engineers, Buffalo, NY. Lake Erie Wastewater Management Study.
S. M. Yaksich, D. A. Melfi, D. B. Baker, and J. W. Kramer.
Journal of Great Lakes Research, Vol. 11, No. 2, p 117-131, 1985. 10 Fig, 3 Tab, 18 Ref.

Descriptors: *Lake Erie, *Nutrients, *Pollution load, Phosphorus, Eutrophication, Great Lakes, Mathematical models, Chlorides, Silica, Nitrogen, Water pollution control.

A nutrient sampling program was established by the Lake Erie Wastewater Management Study in the fall of 1974. This sampling program documented established tributary loading to the lake and the data were used to define nutrient loads to Lake Erie. Total phosphorus during this period had decreased as a result of phosphorus removal at wastewater treatment plants. The effect of these reductions can be seen in the lake concentrations and were predicted by a three basin phosphorus budget model developed in the early 1970s. Soluble orthophosphate loads, chloride loads, and silica loads have decreased over the period. Nitrogen species were highly variable and increased over the period. (Baker-IVI)
W86-01344

CHANCE-CONSTRAINED/STOCHASTIC LINEAR PROGRAMMING MODEL FOR ACID RAIN ABATEMENT - I. COMPLETE COLINEARITY AND NONCOLINEARITY,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-01381

COMPARISON OF TWO MODELS FOR PREDICTING RIVER WATER QUALITY,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-01438

MOBILE OXYGENATION IN THE THAMES ESTUARY,
Thames Water Authority, London (England).
I. M. Griffiths, and P. J. Lloyd.
Effluent and Water Treatment Journal, Vol. 25, No. 5, p 165-169, May, 1985. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality control, *Oxygenation, *Thames River, *England, Thames Bubbler, Dissolved oxygen, Urban runoff, Storm wastewater.

Discharges of storm sewage from the combined sewers in inner London during times of heavy rainfall present the greatest current threat to water quality of the tidal Thames. A prototype oxygenation barge was acquired in response to this threat which is capable of injecting ten ton of pure oxygen per day into the estuary. The Thames Bubbler has been operational for over three years during which time an extensive evaluation of the unit was undertaken. Minor mechanical problems which occurred in the post commissioning phase have been largely overcome and the plant has proved reliable. It has been possible to rapidly deploy the Thames Bubbler in response to deteriorating river conditions and it can easily be kept on station at the point of minimum dissolved oxygen. On at least one occasion the Thames bubbler has prevented a major fish mortality. There is a strong case for acquiring additional units to increase the capacity In providing a means of rapidly responding to changing situations, the Thames Bubbler adds a new dimension to water quality control. Some of the potential applications for use may be in advance of current traditional control methods. (Baker-IV)
W86-01439

WATER FLOW AND SWELLING PRESSURE IN NON-SATURATED BENTONITE-BASED CLAY BARRIERS,
Luleaa Univ. (Sweden).
For primary bibliographic entry see Field 2F.
W86-01455

APPLICATION OF ARTIFICIAL CLAYS IN THE CONTROL OF TOXIC POLLUTANTS,
Chemfix International Ltd., London (England).
For primary bibliographic entry see Field 5E.
W86-01456

PHYSICAL AND CHEMICAL BEHAVIOUR OF CLAY-BASED BARRIERS UNDER PERCOLATION WITH TEST LIQUIDS,
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Grundbau und Bodenmechanik.
H. Simons, and E. Reuter.
Engineering Geology, Vol. 21, No. 3/4, p 301-310, June, 1985. 7 Fig, 1 Tab.

Descriptors: *Clay, *Liners, *Barriers, *Percolation, *Waste disposal, Physical properties, Chemical properties, Water pollution prevention, Bentonite, Cement, Leaching, Adsorption, Ion exchange, Electrostatic force.

Groundwater can be effectively protected from wastes by natural clay deposits where the waste is placed, or by horizontal barriers or vertical liners of clay, bentonite or cement mixtures. The permeability of clay liners for waste deposits was investigated using different aggressive test liquids (distilled water, two organic and five inorganic test liquids). The used test-liquids were analyzed before and after percolation of the liner materials. Leaching or adsorption effects can thus be recognized. After percolation the liner specimens were mineralogically investigated in order to obtain additional evidence on ion exchange processes by comparison with water analyses, and on the long-term durability of the liner materials. Differences in permeability can be attributed to ion exchange processes (desorption or adsorption porcesses) and alteration of the elecrostatic forces in the clay. (Moore-IVI)
W86-01458

MEASURING THE WATERBALANCE OF A THREE-LAYER COVER OF A DOMESTIC WASTE LANDFILL,
Karlsruhe Univ. (Germany, F.R.). Lehrstuhl fuer Angewandte Geologie.
H. Hotzl, H. Neff, H. Walter, and S. Wohnlich.
Engineering Geology, Vol. 21, No. 3/4, p 341-347, June, 1985. 5 Fig, 5 Ref.

Descriptors: *Water pollution control, *Landfills, *Covers, Barriers, Water movement, Lysimeters, Leachates, Permeability, Groundwater protection.

A covering system is described that is to be installed at a domestic waste landfill to reduce the generation of leachate. The landfill will be covered by such a system and simultaneously get an underground barrier for groundwater protection. The research program uses flexible large-scale lysimeters and soil moisture measurements for estimating the water balance within the covering system. The geological strata at the site consist of 40 m of Quaternary sand and gravel underlaid by a minimum 15 m clay layer. The water table is found at a depth of 16-18 m and groundwater is used for drinking water supply at three areas around the site. From the outer edge of the site the slopes show a gradient of 1:3 up to a height of 30 m. The center of the disposal is formed by a plateau. The plateau was designed as a fold-roof type - several segments of 100 m latitude and varying length. In the middle of each segment a water canal is situated, and slopes of 2.5% rise on each flank towards gas vents. The canals drain to the outside with a gradient of 1%. The covering system consists of three layers: sand filter layer, barrier layer, and vegetation support layer. Centered in the testing area are two large scale lysimeters each of a dimension of 9.5 to 16 m. Lysimeter I is designed to observe the watercycle of the covering system within a closed system. Lysimeter II is an open element within the covering system, gathering information on the vertical leachate below the barrier layer without taking horizontal water movements into account. Measurement of soil moisture changes within the covering system is another possibility to quantify the water movement. By using a neutron proble at several measuring points in the testing area, soil water contents at different depths are recorded weekly. (Baker-IVI)
W86-01459

USE OF A CEMENT-BENTONITE CUT-OFF WALL TO CONTAIN POSSIBLE POLLUTANTS FROM A LANDFILL CONTAINING HIGHLY POLLUTED DREDGING SPOILS,
Laboratorium voor Grondmechanica, Delft (Netherlands).
M. Loxham, and F. A. Westrate.
Engineering Geology, Vol. 21, No. 3/4, p 359-365, June, 1985. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Landfills, *Water pollution control, *Spoil banks, *Cutoff walls, Groundwater pollution, Water pollution sources, Heavy metals, Groundwater barriers, Bentonite, Cement.

The approach channels and canals of major ports must be regularly dredged to keep them at depth. The dredged spoil contains pollutants such as heavy metals, PCBs, and pesticides. When this dredging spoil is disposed of either by landspreading or by landfill, potential pollution problems come into play. The dredging spoil from the sea canal at Ghent in Belgium has been landfilled at a specially engineered site at Zelzate. The landfill was designed to an ultimate capacity of some 2.2 million cu m and occupies a total area of about 30 ha. The depot was excavated in fine sand down to a thick clay layer with a low permeability at approximately 25 m below the surface. With this particular dredging spoil, at the ultimate capacity of the landfill, there will be 5600 tons of toxic heavy metals in the fill. To prevent the spread of pollutants from the site to the surroundings a cement-bentonite screen has been constructed down to a thick clay layer 25 m under the surface. Calculations show that this barrier is adequate for the environmental objectives stipulated. The Zelzate site is one of the first and largest examples of the use of cement-bentonite cut-off walls in the field of pollution control. (Baker-IVI)
W86-01460

ACID RAIN: DOUSING COMMUNITY RESOURCES,
K. Anderberg.
American City and County, Vol. 100, No. 2, p 38, 42-44, 49, February, 1985. 2 Fig.

Descriptors: *Acid rain, *Powerplants, *Emissions, *Water pollution control, Sulfur dioxide, Planning, Management, Decision making, Political aspects, Water conveyance, Water treatment.

While almost everyone acknowledges that there is a problem with acid rain, the area of disagreement is centered around whether action is needed now or whether time can be allowed to pass while more data are gathered on the situation. Uncertainty remains the key word in discussions of acid rain. A recommendation regarding the reduction of sulfur dioxide emissions from coal fired electric power generating stations would have only a minimal effect on electric rates; it would still be highly politicized. For public officials, the problem transcends politics. They must be concerned with public welfare. Europe recognized and began dealing with the problem nearly two decades ago. In the US, forests in New England, Appalachia and California's Sierra Nevada Mountains are exhibiting signs of dead, dying and damaged trees believed to have been caused by acid precipitation. The areas usually affected are far removed from the actual source. Northeastern states have perhaps the greatest concern about acid precipitation's effect on water quality, since water distribution systems in this region often have been in place for decades. The challenge to water system operators focuses on the corrosive water's effect on the distribution system. Highly corrosive or acidic water effects a distribution system in three ways. First there is a health danger associated with higher than recommended levels of heavy metals. Second is the deterioration of pipes and joints that occurs, resulting in leaks, restricted flows and shortened lifespan of the system. The most effective method of protecting consumers from corrosive water and associated contaminants is through corrosion control at the treatment plant. Any emissions control program is likely to be deferred this year. The present administration also appears to prefer to wait for research to be completed before taking any action. (Baker-IVI)
W86-01488

LIMITATIONS OF PHOSPHORUS WATER QUALITY CRITERIA,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, S. J. Smith, and R. G. Menzel.
Journal of Soil and Water Conservation, Vol. 40, No. 3, p 283-284, May-June, 1985. 6 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Water quality standards, Runoff, Agricultural chemicals, Water quality control, Streams, Lakes, Rain.

The transport of phosphorus from agricultural land in runoff can result in a deterioration of water quality from accelerated eutrophication. Such problems led to the establishment of critical levels for soluble P at 10 micro-g/l and total P at 20 micro-g/l. Results of a water quality monitoring study in Oklahoma and Texas indicate that P concentrations in surface runoff and groundwater from relatively pristine agricultural land were found to be sufficient to stimulate accelerated eutrophication according to the critical-P-concentration guidelines. In addition, P concentrations in rainfall often exceed the critical levels. If runoff and rainfall do not flow directly into an impoundment, soluble P and total P concentration may increase or decrease as a result of release or uptake and erosion or deposition during transport. It may be unrealistic in most cases to attain or maintain P concentration in surface waters below the critical levels. Consequently, the use of these levels as the sole criteria in quantifying permissible tolerance levels of P in surface water as a result of differing management practices should be discouraged. (Baker-IVI)
W86-01492

WATER QUALITY EFFECTS OF PINE FLATWOODS SILVICULTURE,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
For primary bibliographic entry see Field 4C.
W86-01494

STUDIES ON THE POLLUTION CONTROL OF THE YA-ER LAKE (IN CHINESE),
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
Y. Zhang, Z. Chen, Y. Tan, M. Sun, and D. Zhuang.
Acta Hydrobiologica Sinica, Vol. 8, No. 1, p 113-124, November, 1983. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Water pollution control, *Ya-Er Lake, *China (Peoples Republic), Pesticides, Oxidation ponds, Biodegradation, Biological wastewater treatment, Aquaculture, Eutrophication, Water reuse, Parathion, Malathion, Dimethoate, BHC.

Ya-Er Lake is located in the west part of E-Cheng county, Hubei Province (Peoples Republic of China. In the past it covered about 6000 ha (now 2000 ha) and was one of the main fish production district in the province. Since 1962 the lake was polluted by wastewater of a chemical plant which manufactured parathion, malathion, dimethoate and BHC. The aquatic ecosystem was ruined. About forty percent of fish population were of abnormal form. After the ecological surveys carried out in 1972-1974, the pollution control of Ya-Er Lake was studied. The research works included: survey of the self-purification of pesticides of the lake, simulation experiment on the processes that would occur in the oxidation ponds, and the biological degradation of pesticides in aquatic environment, etc. The pollution control system of Ya-Er Lake consists of the following parts: 1. Oxidation ponds system. At one end of the lake, four oxidation ponds, connected in series, were constructed. The total area is about 187 ha and 3 m in depth. The retention time of wastewater is about 80 days when the amount of the effluent is 70,000 tons per day. The effluent from the pond system is then discharged into another pond for culturing fingerling fish. Therefore the nutritive elements contained in the effluent can be utilized by the fish and the eutrophication process is retarded in the receiving water body. 2. Sewer pipelines, 5.9 km long, between the chemical plant and oxidation

ponds. 3. Two outfall canals (12.8 km long) which run along either side of the oxidation ponds collect and drain the rainwater into the lake. They are also used as water sources for farming. The above facilities were nearly completed in 1976. The operating experience for four years showed that the system was quite successful in district pollution control. The oxidation pond system can effectively reduce the organic wastes. The average removal efficiences for COD, organic phosphate, p-nitrophenol, parathion, malathion, dimethaote and BHC are 77.3, 82.5, 99.3, 98.7, 98.4, 92.9 and 86.2 percent, respectively. The daily waste-water load was 80,000 tons. Biological survey showed that the biotic community in the Ya-Er Lake ecosystem has been recovering since 1977. The rate of abnormal type of fish decreased to 0.1% in 1979. The BHC residues in fish decreased from 15-30 mg/kg to 0.55 mg/kg (in skeletal muscle). The BHC residues of farm products in 1979 were 2.7-9.4 fold less than those before the construction of the oxidation ponds system. (Author's abstract)
W86-01513

COLLIFORD LAKE IN CORNWALL: FROM PROMOTION TO UTILIZATION,
For primary bibliographic entry see Field 6B.
W86-01519

HYDRAULIC CONDUCTIVITY OF TWO PROTOTYPE CLAY LINERS,
Geo-Con, Inc., Pittsburgh, PA.
S. R. Day, and D. E. Daniel.
Journal of Geotechnical Engineering, Vol. 111, No. 8, p 957-970, August, 1985. 13 Fig, 5 Tab, 2 Ref.

Descriptors: *Permeability coefficient, *Clay liners, *Liners, Landfills, Infiltration, Lagoons, Clays.

Two prototype liners were constructed at a site near Austin, Texas, using clays of low and high plasticity. The clays were compacted to 100% of standard Proctor density at a water content slightly wet of optimum using a sheepsfoot roller. The overall hydraulic conductivity (k) of each liner was determined by ponding water on the liners and measuring the rate of seepage. The field-measured k's of the liners were suprisingly high (0.000004 and 0.000009 cm/s). After water in the ponds was removed, laboratory permeability tests were performed on hand-carved samples obtained from the liners, on samples obtained with a thin-walled sampling tube, and on laboratory-compacted samples. Field permeability tests were also performed with ring infiltrometers. The tests showed that: (1) Essentially all of the laboratory tests, even on undisturbed samples, produced a measured k that was approximately 1,000 times less than the field-measured k; and (2) ring infiltration tests showed considerable scatter but the average k was close to the overall field-measured k. The findings raise important questions about whether laboratory permeability tests on compacted clay are relevant to clay liners and reinforce previous suggestions that compacted clay liners may contain numerous hydraulic defects such as fissures, slickensides, zones of poor bonding between clods of clay, and zones of relatively poor compaction. The desirability of field permeability tests is evident from the results reported. (Author's abstract)
W86-01531

CASE STUDY ANALYSIS FOR SEASONAL NITRIFICATION: ECONOMIC EFFICIENCY AND WATER QUALITY PRESERVATION,
Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-01543

MANAGEMENT OF CONTAMINATED DREDGED MATERIAL FROM THE HUDSON RIVER,
Pirnie (Malcolm), Inc., White Plains, NY.
J. S. Reed, J. C. Henningson, and L. Houston.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 216-220. 2 Fig, 6 Ref.

Descriptors: *Environmental effects, *Dredging, *Hudson River, *New York Harbor, *Champlain Canal, Spoil disposal, Estuarine environment, Land disposal, Polychlorinated biphenyls, Waste disposal.

The Hudson River is an active commercial and recreational waterway requiring regular maintenance dredging. Disposal of the dredged material and methods of dredging and volume of material removed must be managed in a manner consistent with the level of sediment contamination. Four studies have been undertaken - two in the upper Hudson, and one each in the estuary and in New York Harbor - which evaluate dredge disposal practices appropriate to each region. The use of dredged material from the New York Harbor is being studied to meet the demand for sanitary landfill cover which is in increasingly short supply in the New York area. The study is being conducted for the New York District Corps of Engineers, as an option to ocean disposal. In the estuary, a 10-year maintenance dredging EIS and management plan were developed for the New York District Corps of Engineers. A total of 92 potential upland disposal sites were identified, a portion of which would be suitable for disposal of hazardous waste. In the upper Hudson consideration was also given to the maintenance dredging program conducted by the NYS Department of Transportation on the Champlain Canal. This evaluation will serve as the basis for an environmental impact on the 10 year maintenance program for the canal. In the Upper Hudson a remedial dredging program was developed for the New York State DEC to remove 'hot spots' containing the highest concentrations of PCB. (Author's abstract)
W86-01564

SIMPLE METHOD TO ESTIMATE LAKE PHOSPHORUS CONCENTRATIONS RESULTING FROM NATURAL, BACKGROUND, LOADINGS,
Pavia Univ. (Italy). Ist. di Entomologia Agraria.
For primary bibliographic entry see Field 2H.
W86-01640

ANALYSIS OF VARIANCES AS DETERMINED FROM REPLICATES VS. SUCCESSIVE SAMPLING,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and F. A. Rovers.
Ground Water Monitoring Review, Vol. 5, No. 3, p 61-64, Summer, 1985. 3 Fig, 9 Tab, 1 Ref.

Descriptors: *Monitoring, *Analysis of variance, *Sampling, Mathematical studies, Groundwater pollution.

Monitoring requirements as specified within the Resources Conservation and Recovery Act rely on increases over background level of the the concentrations of parameters to define when a unit is not in compliance. Evidence of groundwater contamination at a compliance point may be based on statistical comparisons of data from replicate analyses carried out on a single sample. A field test of the variances arising from between samples and within sample replicates indicated that the background concentration is fundamentally important in the statistical significance testing for the compliance point monitoring. Since the variance of the background concentration is best measured by sampling error, as well as analytical error, there is a strong argument that a program of background quality determination should involve successive sampling rather than the splitting of samples into aliquots. (Baker-IVI)
W86-01698

GROUTING AS A REMEDIAL TECHNIQUE FOR BURIED LOW-LEVEL RADIOACTIVE WASTES,
Oak Ridge National Lab., TN. Environmental Sciences Div.
B. P. Spalding, L. K. Hyder, and I. L. Munro.
Journal of Environmental Quality, Vol. 14, No. 3, p 389-396, 1985. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Grouting, *Radioactive wastes, *Waste disposal, Environmental protection, Soil stabilization, Soil properties, Sodium silicate, Polyacrilamide, Permeability coefficient.

Seven grout formulations were tested in the laboratory for their ability to penetrate and to reduce the hydraulic conductivities of soils used as backfills for shallow land burial trenches. Soil from two sites, in Oak Ridge, TN, and Maxey Flats, KY, were used and both are classified as Typic Dystrochrepts. Three soluble grout formulations (sodium silicate, polypropenamide (polyacrylamide), and 1,3-benzenediol (resorcinol)-formaldehyde) were able to both penetrate soil and sand columns and reduce hydraulic conductivities from initial values of ca. 10 to the -4th power m/s to < 10 to the -8th power m/s. Three particulate grouts (lime (calcium oxide)-fly ash, fly ash-cement-bentonite, and bentonite alone) could not penetrate columns; such as formulations would, therefore, be difficult to inject into closed burial trenches. Field demonstrations with both sodium silicate and polyacrylamide showed that grout could be distributed throughout a burial trench and that waste-backfill hydraulic conductivity could be reduced several orders of magnitude. Field grouting with polyacrylamide reduced the mean hydraulic conductivity of nine intratrench monitoring wells from 0.0001 to 10 to the -8th power m/s. Grouting of low-level radioactive solid waste in situ, therefore, should be an effective technique to correct situations where leaching of buried wastes has or will result in groundwater contamination. (Author's abstract)
W86-01712

USING CREAMS AND ECONOMIC MODELING TO EVALUATE CONSERVATION PRACTICES: AN APPLICATION,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 5B.
W86-01715

GROUNDWATER PROTECTION IN SAN FRANCISCO BAY AREA,
California Regional Water Quality Control Board, Oakland.
D. M. Eisenberg, A. W. Olivieri, M. R. Kurtovich, P. Johnson, and L. Pettegrew.
Journal of Environmental Engineering, Vol. 111, No. 4, p 431-440, August, 1985. 1 Fig, 4 Ref.

Descriptors: *Groundwater pollution, *San Francisco Bay, *California, *Environmental protection, Underground storage tanks, Source of pollutants, Water pollution, Legal aspects, Remedial action, Cleanup.

In the San Francisco Bay Region, the Regional Water Quality Control Board is now regulating approximately 140 sites where toxic chemicals have contaminated groundwater. Many of these were located through the Board's Underground Tank Leak Detection Program, which required subsurface investigations at the sites with underground solvent tanks. New ordinances and state laws are expected to result in the discovery of hundreds more contamination sites in the next few years. The Regional Board is developing a ranking methodology to assign priorities among cases and a set of guidelines for establishment of clean-up objectives on a site-by-site basis. Appropriate regulatory mechanisms have been selected to enforce the necessary investigation and clean-up activities. (Author's abstract)
W86-01724

DESIGN CONSIDERATIONS FOR A NOVEL LANDFILL LINER,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
A. C. Demetracopoulos, and L. Sehayek.
Journal of Environmental Engineering, Vol. 111, No. 4, p 528-539, August, 1985. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Landfill liners, *Design criteria, *Membranes, Environmental protection, Leachates, Linings, Diffusion coefficient.

A novel landfill leachate liner design consisting of a series of v-shaped contiguous elements constructed from an impervious membrane, a boxed soil layer saturated with clean water, and a gravel layer is proposed. Certain idealized boundary conditions are stipulated and an analytical solution is given for the diffusional mass transport of leachate through the saturated layer. This is used to assess the maxiumum value and time-of-occurrence of leachate concentration at the impervious membrane. It is shown that these two important quantities are sensitive to the diffusion coefficient and the thickness of the saturated layer. A method is formulated for the estimation of the diffusion coefficient, accounting for the type of contaminant, the effect of the porous medium, and the possibility of contaminant adsorption on the soil matrix. The overall procedure would be valuable in estimating the potential of destruction of the impervious membrane from the chemicals contained in the leachate. (Author's abstract)
W86-01730

HAZARDOUS WASTE CLEANUP: THE PRELIMINARIES,
Environmental Protection Agency, New York. Region II.
K. Amos.
Civil Engineering, Vol. 55, No. 8, p 40-43, August, 1985. 5 Fig.

Descriptors: *Water pollution control, *Cleanup operations, *Landfills, *Waste disposal, *Niagara River, Hazardous substances, Groundwater pollution, Monitoring.

An EPA suit filed in 1979 named four Hooker dump sites that were polluting the Niagara River. The parties involved agreed to negotiate remedial programs for each of the four sites in turn. S-Area, second on the list, may serve as a model for other negotiated settlements. It provides for a flexible plan, open to consideration of alternate technologies that may be developed in the future. It contains a phased approach to both defining and evaluating existing problems, then suggesting remedies. It requires monitoring for at least 35 years or until no danger remains. S-Area is an eight acre landfill built in 1947 on partially reclaimed land beside the river. Wastes were dumped into open trenches 18 ft deep even though groundwater was struck at 4 ft. The remedial plan set forth in the approved settlement agreement begins with a surveys-and-studies program similar to those outlined for Superfund sites. Flexibility, extensive use of computer models, and extensive monitoring programs for hydraulics, tracer and other chemicals will assure the remedial plan's effectiveness. An important technical remedy proposed for S-Area is the upward hydraulic gradient concept, innovative and as yet untried. (Baker-IVI)
W86-01738

HEALTH EFFECTS OF INDIRECT POTABLE WATER REUSE,
Los Angeles County Sanitation Districts, Whittier, CA.
M. H. Nellor, R. B. Baird, and J. R. Smyth.
Journal of American Water Works Association, p 88-96, July, 1985. 1 Fig, 6 Tab, 48 Ref.

Descriptors: *Water reuse, *Potable water, *Public health, Groundwater recharge, Toxicity, Percolation, Hydrogeology, Epidemiology, Chemical content.

Plans for expansion of water reuse through groundwater replenishment have been constrained by concerns regarding the potential impacts on health of indirect potable reuse, particularly the effects of exposure to trace organics, the presence of which may be exacerbated by groundwater replenishment activities. A five-year, multidisciplinary research project was undertaken to evaluate the effects on health of using treated wastewater for groundwater replenishment. The study focused on the Whittier Narrows Groundwater Replenishment Project in Los Angeles County, California, where replenishment with a mixture of imported river water, stormwater, and reclaimed wastewater has been practiced since 1962. The study included: characterization of the quality of the water; toxicological and chemical studies of the water; percolation studies to evaluate the efficacy of soil for attenuating inorganic and organic chemicals in reclaimed water; hydrogeology; epidemiological studies of populations ingesting reclaimed water. The proportion of reclaimed water currently used for replenishment had no measurable impact on either groundwater quality or human health. Recommendations for optimization of groundwater replenishment with reclaimed water are included. (Moore-IVI)
W86-01747

OPTIMIZATION MODELING OF WATER QUALITY IN AN UNCERTAIN ENVIRONMENT,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
D. H. Burn, and E. A. McBean.
Water Resources Research, Vol. 21, No. 7, p 934-940, July, 1985. 2 Fig, 2 Tab, 33 Ref, 1 Append.

Descriptors: *Optimization, *Water quality, *Model studies, Probability, Stochastic process, Dissolved oxygen, Wastewater treatment, Simulation, Costs.

A comprehensive approach to water quality modeling could incorporate the stochastic nature of water quality as a means of assuring compliance with probabilistic water quality standards. An optimization model with an ability to reflect uncertainties present in water quality problems is described. The technique employed is chance constrained programming wherein probabilistic constraints in a water quality optimization problem are replaced with their deterministic equivalents. To illustrate aspects of the proposed methodology, a case study is described which involves the determination of the optimal treatment level at two sources in order to satisfy two objectives of maximizing water quality (at a series of four locations) and minimizing treatment costs at the two sources. Water quality is assumed to be represented by the dissolved oxygen concentration in the river. The uncertainty inherent in the random elements of the problem is characterized using first-order uncertainty analysis for the case study. A lognormal distribution provided a satisfactory fit to the distribution of dissolved oxygen deficit. In choosing an appropriate distribution for this problem, consideration should be given to the loading condition and the probability level which is of interest. (Moore-IVI)
W86-01764

USE OF MACROPHYTES FOR TREATING AGRICULTURAL RUNOFF,
For primary bibliographic entry see Field 5D.
W86-01826

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

COMPUTER AIDED MAPPING PROJECT AIDS SEVERN TRENT,
N. McLeod.
Water Services, Vol. 89, No. 1072, p 161-163, June, 1985.

Descriptors: *Severn Trent Water System, *Mapping, *Computers, Automation, Planning, Water supply, Water distribution, Wastewater facilities, England.

The Lower Severn Division, on of the eight divisions of the Severn-Trent Water Authority (England) supplies water to and treats sewage from 780,000 people. The Division is also responsible for maintaining some 658 km of rivers and estuaries. Lower Severn began investigating computer based mapping in May of 1982. A four person multidisciplinary team was set up, which included two independant consultants. Benchmark tests were established to demonstrate to the prospective user the strengths and weaknesses of the systems competing against each other. From the results of the benchmark tests a three workstation system was selected on an initial one-year rental contract. The mapping software is accurate to 1 mm on the ground and stores data on one of 32 reference files, each of which can have 63 levels. Lower Severn found it difficult to produce a financially sound case to purchase computer equipment for mapping purposes only. Thus it was necessary to exploit the full potential of the system's database capability to produce reports of all kinds. The real payoff will come when all the public utilities and the highway authorities all begin to communicate in specifying a system that will be of benefit to them all, and ultimately of benefit to the paying customers, the consumer. (Baker-IVI)
W86-01631

CALCULATING WITH MICROCOMPUTERS,
J. Houston.
Water Services, Vol. 89, No. 1072, p 164-166, June, 1985. 3 Fig, 6 Ref.

Descriptors: *Computers, *Water supply development, Hydrogeological analysis, Spatial analysis, Statistical analysis, Automation.

Microcomputer hardware is now well advanced, capable of carrying out most of the tasks required by professional water engineers. By comparison software has not kept pace and only now are program packages becoming available which use facilities to the full. A wide range of programs are available for the simpler tasks but there are still very few available for more complex data handling. The ease of access to microcomputers and their flexibility means that the software for these machines should not be the preserve of computer scientists. Programs should be and are being developed with the emphasis on ease of use but they are not a substitute for technical knowledge. Microcomputers must support the professional engineer, not replace him. (Baker-IVI)
W86-01632

MEASURING VALUES FOR ENVIRONMENTAL RESOURCES UNDER UNCERTAINTY,
New South Wales Univ., Kensington (Australia). School of Economics.
D. R. Gallagher, and V. K. Smith.
Journal of Environmental Economics and Management, Vol. 12, No. 1, p 132-143, June, 1985. 1 Fig, 17 Ref.

Descriptors: *Planning, *Policy making, *Uncertainty, Water pollution control, Environmental protection, Values, Decision making, Risk.

The relationship between conventional measures of the benefits from changes in environmental amenities under certainty and an individual's valuation of such changes under uncertain conditions is considered. The basic framework used in developing the conditions when the Hicksian compensating and equivalent measures of consumer surplus will bound an individual's value for a change in the likelihood of experiencing an improvement in an environmental amenity is introduced. The analysis is conducted within a contingent commodity framework with state-dependent preferences. This approach allows an individual's valuation of a change in access to an environmental amenity to be considered with and without the ability to efficiently allocate risk. This framework is used to evaluate the effects of the allocation of risk on the relationship between an individual's valuation of change in the access conditions and the conventional measures of consumer surplus for certain changes in the amenity resources. The paper concludes by considering the implications of the results for efforts to estimate the values associated with changes in the availability of uncertain environmental amenities. (Baker-IVI)
W86-01685

HYDROPOWER'S NEWEST GENERATION,
H. Smallowitz.
Civil Engineering, Vol. 55, No. 8, p 46-49, August, 1985. 3 Fig.

Descriptors: *Water resources development, *Hydroelectric power, *Canals, Small hydropower, Planning, Dam construction, Dams, Enviromental effects, Hydroelectric plants.

The Great Falls, Paterson, NJ project is based on a system of canals constructed in the late 1700s to spur small industry in the fledgling US, and develop independence from the economy of Great Britain. While the mills and factories the canals once powered have long since closed, the waterways are still capable of producing 4900 to 11000 Kw. The city of Paterson hopes to make use of this energy source in the future. In North slope, Alaska, the Susitna project is actually made up of two major developments on the Susitna River, some 180 mi North and East of Anchorage. The Eldred L. Field Project, in Lowell, Massachusetts is on a canal system that dates back to 1792. Efforts to make use of this system in modern times necessitated making certain that historical and environmental factors were considered. In Bumcombe County, North Carolina, near Ashville, developers are bringing out of retirement an abandoned hydroelectric plant. The Craggy Dam was originally constructed in 1904. A proposal to tap electricity from the flow of water to Jersey City, New Jersey's water taps is beset with regulatory problems. Plans call for two small hydroplants to be installed at the Boonton Reservoir, 25 mi west of the city. An innovative use of existing mud gates in the reservoir will also make it cost effective to generate 2 Mw more from the facility. (Baker-IVI)
W86-01739

COMPUTER KEEPS NEW ORLEANS' HEAD ABOVE WATER,
Daniel, Mann, Johnson and Mendenhall, New Orleans, LA.
M. A. Ports.
Civil Engineering, Vol, 55, No. 8, p 56-58, August, 1985. 1 Fig.

Descriptors: *Drainage control, *New Orleans, *Louisiana, *Computers, *Drainage systems, Data handling, Storm runoff, Canals, Simulation, Flood peak, Pumping rate.

Drainage problems have beset the city of New Orleans, Louisiana since its founding in 1718. By 1983 it was apparent that an adequate drainage system was necessary. The survey of the topography of the city revealed that the city is saucer shaped. A plan to lift storm water up and out of the city called for an extensive network of canals and pumping stations to Lake Pontchartrain and Lake Borgne. In order to simulate successfully the complex network of interconnected open and covered canals, conduits and pumping stations under both surcharged and free flowing conditions, any potential model must be capable of predicting for each area, for any storm, the time and elevation of peak flows, the maximum pumping rates required to handle peak flows, the above ground flood slopes and the time needed to pump away stormwater runoff. Designers worked to plan the most effective and cost effective improvements. The models for each area were formulated only after testing hundreds of trial simulations. Without the aid of an in-house minicomputer, such a vast array of data would not have been processed with more than 800 simulations completed in only 15 months. (Baker-IVI)
W86-01740

TWO PROJECTS BECOME ONE,
Bureau of Reclamation, Durango, CO.
W. M. Roche, and J. W. Davison.
Civil Engineering, Vol. 55, No. 8, p 64-65, August, 1985. 2 Fig.

Descriptors: *Water resources development, *Multipurpose projects, *Dolores Project, *McElmo Project, *Colorado, Salinity control, Water management, Water supply development, Canals, Linings.

The Dolores and McElmo projects, both near Cortez, Colorado, were begun at different times. The Dolores Project, located in the Dolores and San Juan River Basins was set up to develop water from the Dolores River for municipal, industrial, and irrigation supplies; power; food control; and fish, wildlife and recreation. Just south of the Dolores Project at the McElmo Unit sites, studies were underway to determine the most cost-efficient alternative for reducing salt concentrations. Once preliminary investigations showed that creating a $34 million McElmo Unit that was separate from the Dolores Project would be inefficient, representatives from both projects met to discuss possible joint efforts. The combined project calls for enlarging and lining the Lower Hermana Lateral and Highline Ditch to handle the flows of Towaoc and Rocky Ford canals. Depending on soil conditions and right of way restrictions, either earth, concrete or plastic membrane lining will be used. Design for other portions of the project including canal enlargement and salinity control, will be completed in stages. (Baker-IVI)
W86-01741

PROBABILITY DISTRIBUTION MEMBERS OF A RANKED SAMPLE,
Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
L. D. Ratkovich.
Water Resources, Vol. 11, No. 3, p 179-185, May-June, 1984. 2 Fig, 3 Tab, 8 Ref. Translated from Vodnye Resursy, No. 3, p 15-22, May-June, 1984.

Descriptors: *Probability distribution, *Autocorrelation, *Time series analysis, Hydrology, Geophysics, Water management,.

When performing hydrologic and water management calculations, it is often necessary to estimate the probability of a particular member of a time series composed of geophysical quantities. The presence of autocorrelation of water-balance components in time series has been proven. Problems remain as to what probabilities the ordinates of a ranked sample of correlated quantities should be referred and what random errors can occur in the case. For a series length of more than 30 members the effect of autocorrelation on the estimates of empirical probabilities of a ranked sample is not evident. Even in this case, when the values of the autocorrelation coefficient are high, the effect of autocorrelation is comparable to the difference between the probabilities calculated by given equations. An equation is also provided for giving a sample estimate of probability with consideration of autocorrelation and is recommended for small samples. Further investigation should be geared toward a theoretical analysis of the distributions of the sample estimates of probabilities of correlated samples and, in particular, a refinement of the confidence limits. Of definite interest is an analysis of the effect of autocorrelation on errors in the estimates of the random variable itself on the basis of the calculated probability values. (Baker-IVI)
W86-01817

6B. Evaluation Process

LOWER MAE PING PROJECT, THAILAND,
Crippen International Ltd., Vancouver (British Columbia).
G. D. A. Akins, P. R. Blinch, and P. Premchun.
Water International, Vol. 10, No. 2, p 52-56, June, 1985. 2 Fig, 2 Ref.

Descriptors: *Lower Mae Ping Project, *Thailand, *Hydroelectric plants, Water resources development, Economic aspects, Design criteria, Water management, Pumped storage, Diversions, Flood control.

The Lower Mae Ping Project was designed to provide more hydropower generating capacity to the power system of Thailand, while increasing the volume of water available for irrigation in the dry season. This will be achieved through installation of a reversible pump/turbine at Bhumibol, an existing hydropower dam, construction of a low head hydropower scheme downstream of the dam, and diversion of flows towards these facilities from an adjacent river. Technical features of the project are outlined. Principal design constraints on the system include an affect on the EGAT power system, downstream water availability and the flood control function of Bhumibol dam. Environmental and social aspects are briefly noted along with benefits, costs, and scale of the project. Secondary benefits will include local irrigation, flood control, and inland fishery development. (Baker-IVI)
W86-01374

GROUNDWATER IN WATER RESOURCES PLANNING: CONJUNCTIVE USE,
Universidad Politecnica de Valencia (Spain).
For primary bibliographic entry see Field 4B.
W86-01375

NIGERIAN WATER RESOURCES AND THEIR MANAGEMENT,
Nigeria Univ., Nsukka. Dept. of Civil Engineering.
G. U. Ojiako.
Water International, Vol. 1, No. 2, p 64-72, June, 1985. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Nigeria, *Water resources development, *Developing countries, Water management, Decision making, Planning, Water supply, Surface waters, Rainfall, Groundwater, Institutional constraints.

The potentiality and management of the water resources of Nigeria are examined and early achievements of the authorities charged with the multi-purpose development of this resource are reviewed. The annual mean rainfall distribution ranges from about 157.5 inches at the coast to practically zero at the northern border and an average annual mean of 47.2 inches for the whole country. Surface sources include the River Niger, the third largest river in Africa. In addition there are also the River Benue, Cross River, Imo, Sokoto, Ogun, Anambra, and Kaduna Rivers together with several streams and channels, lakes and ponds which provide a nationwide web of drainage basins. The quantities of runoff from the drainage basins vary widely and depend upon a large number of factors the most important of which are the amount and intensity of rainfall, the climate and vegetation as well as geological, geographical and topographical features of the area. Major ground water reserves exist in numerous localities all over the country and have been conservatively estimated as 30 times the level of surface flows. The establishment of River Basin Authorities remains in Nigeria the greatest landmark made since independence in the development of the economy. The accelerating agricultural activities of the Authorities will return the country to its original position of an agricultural based economy capable of earning substantial foreign exchange and reducing overdependence on oil exports. The problems which face the Basin Authorities and tend to reduce their pace of development, such as financial constraints in fundings, and insufficiency of adequately trained technical and administrative manpower, can easily be overcome with the cooperation of developed countries and the goodwill of international organizations. At home, the tasks of the Authorities will be made easier with the cooperation of local financial houses, local industries, State Governments and organizations with interests in water development as well as institutions of higher learning. (Baker-IVI)
W86-01376

AGRICULTURAL BENEFITS FOR SENEGAL RIVER BASIN,
Army Engineer Battalion (79th), APO New York 09360. Company B.
For primary bibliographic entry see Field 3B.
W86-01432

BIG CHALLENGE OF SMALL WATER SYSTEMS,
Pirnie (Malcolm), Inc., White Plains, NY.

M. J. Shelstad, and J. Bennett.
American City and County, Vol. 100. No. 2, p 34-36, 38, February, 1985. 2 Fig.

Descriptors: *Water conveyance, *Management, Planning, Decision making, Water management, Water supply, Water treatment.

Small water systems must accomplished their mission with very limited resources. Because their small size cannot justify constant attention, both management and operation are part time efforts. Many small water systems are not economically viable. Often they may employ operators who are poorly paid and lacking strong motivation or without proper training and certification without knowledge enough to cope with the complex provisions of the Safe Drinking Water Act. Thus these systems are more likely to violate drinking water standards. Among possible solutions to these problems is consolidation which can occur in a variety of ways: small private utilities can merge into larger organizations or public agencies, usually at the county level, can take charge. Mergers and takeovers are not the only way to achieve the benefits of a regional system. Another mechanism is the cooperative agreement among water systems to share resources and services. Management services can be shared also, enabling such functions as purchasing, maintenance, bookkeeping and billing to be centralized. Avenues for technical assistance and financial assistance are briefly noted with some examples given. (Baker-IV)
W86-01487

COLLIFORD LAKE IN CORNWALL: FROM PROMOTION TO UTILIZATION,
D. Battersby, T. A. Johnston, and J. D. Evans.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 207-224, June, 1985. 9 Fig, 2 Tab.

Descriptors: *Clifford Lake, *England, *Reservoirs, *Water supply development, Water resources, Water supply, Water demand, Dam construction, Fish management.

Extensive investigations were made to determine the best route to take for meeting the water demand of the Cornwall River Authority area until the year 2001. The construction of Colliford Lake, the largest reservoir in Cornwall, fulfilled a key role in the water resource strategy thus developed. The total area to be supplied from Colliford Lake in conjunction with existing sources of supply amounts to some 3,322 sq km. Early investigations had ruled out the possibility of the use of groundwater, desalination, an estuarial barrage, or bunded storage for water resource development. Details are provided of the site selection process and dam construction. Reinforced concrete structures described include overflow works, draw-off valve tower, access gallery/overflow culvert, and the inspection gallery/cut-off. Construction of a subsidiary dam, Soimonstone Embankment, is also described. The river Fowey is well known for its salmon and sea trout fishing. To mitigate the loss of production due to the construction of the Colliford Dam, a fish trap and fence have been built across the river immediately downstream of Colliford Dam with an adjoining fish hatchery. Impounding began at the end of July 1983 and rainfall amounted to about 93% of the 15 year average during the first year. Drought occurred in the summer of 1984. During the early months, discharges to the St. Neot river were mainly limited to the compensation flow of 5.7 Ml/d. However, as the drought made itself felt, augmentation discharges were made. Prior to the augmentation release, temperature and dissolved oxygen monitoring had indicated that the lake was becoming thermally stratified and there was oxygen deficiency at the lower levels. The concentrations of iron, manganese, ammoniacal nitrogen and hydrogen sulfide had also increased in the deeper water although the algal productivity was low. Thus, in mid-August, the aeration compressor was used intermittently and it ran continuously during September and seemed to be effective in mixing, reoxygenating, and reducing the chemical concentrations in the water, although more experience will be needed to establish guidelines for economic use. (Baker-IVI)
W86-01519

HOW TO PUT MORE PUBLIC INTO PUBLIC WORKS,
Black and Veatch, Kansas City, MO.
T. E. Decker, and L. J. Saiger.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 756-762, July, 1985. 4 Fig.

Descriptors: *Public relations, *Education, Public participation, Public opinion, Attitudes, Utilities, Wastewater facilities, Water supply development.

A detailed list is presented of public involvement and education activities and methods that can be used to promote the acceptance of public works facilities, including wastewater and water supply facilities. A brief overview is given of a public participation program for their facilities plan demonstrated that a designed, comprehensive public campaign using standard activities can be successful in many instances. Case histories clearly show that it is occasionally necessary to use very specialized and intensive public relations techniques to educate and satisfy the public. These two case histories prove that public education, involvement, and relations activities are very important at all stages of a project; that words, diagrams, and photographs are not always sufficient to educate individuals about the impact that public works facilities may have on their lives; that the willingness of a municipality or utility to commit money and take the time and effort needed to appease public concerns is usually rewarded; and that, if treated fairly, individuals will generally be willing to compromise and respond positively. The keys to fair treatment are compassion, honesty, imagination, generosity, and perseverance. (Baker-IVI)
W86-01542

SOUTHERN OCEAN AND MARINE POLLUTION: PROBLEMS AND PROSPECTS,
George Washington Univ., Washington, DC. Dept. of Political Science.
C. C. Joyner.
Case Western Reserve Journal of International Law, Vol. 17, No. 2, p 165-194, Spring, 1985. 174 Ref.

Descriptors: *Planning, *Water pollution control, *Marine pollution, *International law, Legal aspects, Marine sediments, Oceans, Natural resources development, Antarctic region.

The nature of marine pollution is examined as it has come to affect global ocean space. An assessment is provided of the extent to which pollutant contamination is presently encroaching upon the Southern Ocean's ecosystem, as well as the possible threates which potential hydrocarbon development in or around Antarctica would likely pose for the circumpolar seas. Finally, an analysis is performed of the various international legal instruments which have been purposefully designed and implemented for curtailing marine pollution. In this connection, specific reference is made to the protection of the Antarctic maritime area. As a result of this analysis, hopefully the environmental degradation associated with marine pollution in the circumpolar region will be better understood and appreciated. More importantly, it is necessary to realize that new, viable, and effective international legal safeguards are imperative if the fragile ecosystem of the Southern Ocean is to be adequately protected and prudently managed. (Baker-IVI)
W86-01686

EVALUATING ALTERNATIVE INVESTMENT PROGRAMS FOR THE MEDITERRANEAN-DEAD SEA PROJECT,
Mediterranean-Dead Sea Co. Ltd., Jerusalem (Israel).
A. Gross, and J. Zahavi.
Water Resources Research, Vol. 21, No. 7, p 905-916, July, 1985. 7 Fig, 29 Ref, 1 Append.

Descriptors: *Israel, *Mediterranean-Dead Sea Project, *Evaluation, *Investment, Alternative planning, Optimization, Hydroelectric plants, Economic feasibility, Canals, Tunnels.

The sharp difference in elevation between the Mediterranean and the Dead Sea and the need to replace the water withdrawn from the Dead Sea by water from another source are the key to ambitious Mediterranean-Dead Sea (MDS) project. This project is intended to convey water from the Mediterranean to the Dead Sea via canals and tunnels utilizing the height difference of close to 400 m to generate hydroelectric energy. A methodology, geared toward the prefeasibility study, is devised for evaluating alternative investment programs in the MDS project, which is based on comparing the optimal configuration for each alternative route of the water carrier. The maximal energetic benefits are calculated using two interrelated optimization problems: a multiperiod optimization, involving dynamic programming, to find the optimal operating regime of the system over time, and a one-period optimization, imbedded in the multiperiod optimization, involving probabilistic methods, to find the loading point of the hydro unit that maximizes the value of the energy displaced. Cost-benefit analysis is used to find the optimal size of the hydroelectric components, including the hydro unit size and the water carrier diameter. The model has been applied to evaluate the economic feasibility of the MDS project and to rank the various alternatives by economic merit. The results of this study indicate that the MDS project is viable in all its alternatives with the Central project yielding the largest net benefits. Because the Central alignment introduces many other problems, mainly hydrological, it has been abandoned in favor of the next most economical plan, the Southern alignment. (Moore-IVI)
W86-01761

HYPERGAME ANALYSIS OF THE LAKE BIWA CONFLICT,
Tottori Univ. (Japan). Dept. of Civil Engineering.
N. Okada, K. W. Hipel, and Y. Oka.
Water Resources Research, Vol. 21, No. 7, p 917-926, July, 1985. 1 Fig, 6 Tab, 29 Ref.

Descriptors: *Lake Biwa, *Japan, *Hypergame analysis, *Water allocation, Model studies, Water management, Resource management, Conflict analysis, Decision making.

When there are misunderstandings among participants in a water resources conflict, hypergame analysis can be used to systematically model the conflict and predict the compromise resolutions. In order to demonstrate the efficacy of using hypergame analysis for studying water resources management problems, it is applied to the Lake Biwa conflict in Japan. This dispute constitutes a typical example of a water allocation conflict where downstream users would like more water from the upstream controllers of the major source of the water. Furthermore, each participant or player in the Lake Biwa dispute has misperceptions about the other players' preferences. Besides predicting the different resolutions which each of the players envisioned, hypergame analysis correctly forecasts the compromise resolution that occurred historically. (Author's abstract)
W86-01762

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,
For primary bibliographic entry see Field 5D.
W86-01490

QUESTION OF RATES,
Consumers/Pirnie Utility Services Co., Inc., Hamden, CT.
H. F. Hanson.
American City and County, Vol. 100, No. 6, p 38, 40, 42, June, 1985.

Descriptors: *Economic aspects, *Water rates, Metering, Planning, Management, Utilities, Financing.

Through the years, water utilities have supplied treated water to their customers at the lowest cost, consistent with quality and reliability requirements. This approach has sometimes caused water utilities to become victims of their own success when customers began taking for granted the dependable flow of water at what some consider artificially low prices. Customers and utilities alike are now confronted with the lasting results of this practice. The capital assets of utilities are long-lived, remaining in service for 50 years or more. The initial investments made in the 1930s have not generated sufficient depreciation in funds to finance the replacement or expansion required at today's high construction costs. Suburban expansion of older cities means that more customers must be provided with water over greater distances. New or expanded facilities often must be built to meet expected growth before the customers are in place to pay for service. Two chief problems face water utility managers: how to raise capital, and how to obtain higher rates to pay for the needed improvements. One alternative is the imposition of system development revenues, such as connection fees or cost-of-service charges. Demand rates for utility systems have also received consideration. An emerging technology that will enable utilities to monitor customers' consumption accurately on a frequent basis is automated meter reading. (Baker-IVI)
W86-01491

EFFLUENT REGULATION AND LONG-RUN OPTIMALITY,
University of Southern California, Los Angeles. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W86-01684

PAYING FOR REUSE WATER,
CH2M Hill, Inc., Portland, OR. Water and Wastewater Economics.
C. W. Corssmit.
Journal of American Water Works Association, p 78-83, July, 1985. 2 Fig, 1 Tab.

Descriptors: *Water reuse, *Pricing, Cost allocation, Cost-benefit analysis, Water demand, Financial feasibility.

To arrive at satisfactory financing plans and price schedules for reuse water, economic feasibility studies of the proposed projects, including consideration of the no-action alternative, should be undertaken before engaging in more traditional financial planning. This helps to determine the benefits and costs and a proper framework for cost allocations. A market analysis should also be performed to make sure there is a demand for reuse water and to determine what prices people would be willing to pay for it. Typically, revenues obtained from sales of reuse water will be less than for potable water and would possibly not be equal to the cost of serving reuse customers. Methods for redistributing the deficits to other water users are suggested. (Author's abstract)
W86-01745

CONSERVATION USING A RATE OF RETURN DECISION RULE: SOME EXAMPLES FROM CALIFORNIA MUNICIPAL WATER DEPARTMENTS,
California Univ., Santa Barbara. Dept. of Economics.
For primary bibliographic entry see Field 3D.
W86-01763

VOLUMETRIC PRICING OF AGRICULTURAL WATER SUPPLIES: A CASE STUDY,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
R. C. Griffin, and G. M. Perry.
Water Resources Research, Vol. 21, No. 7, p 944-950, July, 1985. 5 Tab, 17 Ref.

Descriptors: *Volumetric pricing, *Irrigation water, *Rice, *Texas, Consumptive use, Econometric models, Economic aspects, Model studies, Pricing.

Models of water consumption by rice producers are conceptualized and then estimated using cross-sectional time series data obtained from 16 Texas canal operators for the years 1977-1982. Two alternative econometric models demonstrate that both volumetric and flat rate water charges are strongly and inversely related to agricultural water consumption. Nonprice conservation incentives accompanying flat rates are hypothesized to explain the negative correlation of flat rate charges and water consumption. Application of the results suggests that water supply organizations in the sample population converting to volumetric pricing will generally reduce water consumption. (Author's abstract)
W86-01766

6D. Water Demand

NILE INSIDE THE SUDAN - INCREASING DEMANDS AND THEIR CONSEQUENCES,
King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.
A. M. A. Salih.
Water International, Vol. 10, No. 2, p 73-78, June, 1985. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Water resources development, *Water demand, *Nile River, *Sudan, Decision making, Management, Water quality control, Irrigation water, Water management, Environmental effects.

Water budgets of the Nile and its major tributaries have been reviewed and compared with changes in the rate of water abstraction for irrigation purposes in the period starting from Sudan's independence in 1956 to the medium range future. Considerable quantities of the Nile's average annual water budget were to be abstracted for irrigation schemes inside the Sudan in 1977. The effects of these vast abstractions are especially felt, during the low flow season, along many reaches of the Nile and its major tributaries. These abstractions reached 64% of the Blue Nile's average flow during the eight months of the low flow season in 1977. Due to a trend in water use, these effects are expected to worsen in the short and medium term future. Numerous harmful consequences result from these heavy water abstractions, including the neglected rights of the downstream population and the environmental hazards. Reservoir compensation ordinances have existed since 1937 and an Environmental Health Ordinance was issued in 1975. If these ordinances were strictly applied, many consequences would have been reduced or eliminated. Unfortunately these ordinances cannot be effectively implemented due to a lack of monitoring and operational capabilities. They must form an integral part of a comprehensive national water resources management plan. (Baker-IVI)
W86-01377

ETHIOPIAN INTERESTS IN THE DIVISION OF THE NILE RIVER WATERS,
Sanje Zivanovica 9, Belgrade, Yugoslavia.
D. Jovanovic.
Water International, Vol. 10, No. 2, p 82-85, June, 1985. 1 Fig, 1 Tab.

Descriptors: *Nile River, *Ethiopia, *Egypt, *Sudan, *Kenya, *Water demand, Water supply development, Irrigation water, Water resources development, Blue Nile, White Nile, Water management.

The main tributaries of the Nile River are the Blue Nile and the White Nile. The source and nearly the entire catchment area of the Blue Nile are in Ethiopia, while the White Nile basin is shared by several countries. The Nile Water is being used for irrigation, hydropower production, domestic and industrial water supply, navigation, as well as for other purposes. It is likely that Ethiopia will claim about 40 x 10 to the 9th power cu m of Nile water for irrigation. The Nile flow through Sudan and Egypt will be reduced by the same water quantity. Similarly, but on a smaller scale, water used for irrigation in Uganda, Kenya and Tanzania would reduce the White Nile flow. The gain in water after possible reclamation of the Sud and other swampy areas also needs to be taken into account. Sudan and particularly Egypt need all the water they can get and are highly dependent on the water claimed by the other countries involved. Obviously a compromise needs to be found, because if upstream countries maximally satisfy their needs, this could have severe implications for Sudan and particularly Egypt. It seems unlikely that satisfactory agreement can be achieved in the near future between all the parties involved. In order to develop criteria to be used for future water division, all countries need to prepare studies that justify their water demands. Preliminary agreement on the size, accuracy and standards for these studies are needed in order to make them comparable. (Baker-IVI)
W86-01379

TRADING 404 PERMITS FOR ENHANCED FISH HABITAT,
For primary bibliographic entry see Field 6G.
W86-01681

MEASURING VALUES FOR ENVIRONMENTAL RESOURCES UNDER UNCERTAINTY,
New South Wales Univ., Kensington (Australia). School of Economics.
For primary bibliographic entry see Field 6A.
W86-01685

WINNING THE WAR AGAINST UNACCOUNTED FOR WATER,
Pitometer Associates, Upper Montclair, NJ.
M. Siedler.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 119-135, June, 1985.

Descriptors: *Water distribution, *Monitoring, *Metering, Water use, Water demand, Water conveyance, Water audit, Leakage.

An efficiently designed, operated and maintained water distribution system will save money for the utility and its ratepayers. The do it yourself water audit method involves the performance of a self improvement water audit, which is aimed at isolating the problem by the use of per capita water consumption data. In order to work the audit through the process, the water system must have available the following information: accurate plant production figures showing the gross volume of water delivered to the system, two ways to determine total water sold to residential customers only, total residential population served by the utility, and true per captia residential consumption. Once benchmark data are established for the representative sub network, the information can be used to determine if the unaccounted for water problem for the total network is caused by leakage or by under registration of domestic meters. Ways to determine the extent of a metering problem are considered. (Baker-IVI)
W86-01751

HYPERGAME ANALYSIS OF THE LAKE BIWA CONFLICT,
Tottori Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W86-01762

MUNICIPAL WATER DEMAND STUDY, OKLAHOMA CITY AND TULSA, OKLAHOMA,
Oklahoma Water Resources Board, Oklahoma City.
R. Cochran, and A. W. Cotton.
Water Resources Research, Vol. 21, No. 7, p 941-943, July, 1985. 2 Tab, 13 Ref, 2 Append.

Descriptors: *Water demand, *Oklahoma City, *Tulsa, *Oklahoma, Income, Price, Precipitation, Air temperature, Municipal water, Household size.

Although population is an important variable in forecasting future water demands, it does not account for all of the variation in quantity demand. A multiple regression model was used to study the

factors which influence water consumption in Oklahoma City and Tulsa, Oklahoma during the 20-year period of 1961 through 1980. The explanatory variables utilized in the model include the average price of water per thousand liters; constant per capita income; average monthly precipitation measured in millimeters; average monthly temperatures in C; and number of households per thousand population. Whether considered alone or included with other variables, the income factor was always found to be a significant determinant of water demand. Although price was significant in each city when used alone, it did not have as high a correlation value as income and was not found to be significant in Tulsa when joined to other variables. The consistent decline of real average price of water in both cities over a 20-yr period should be noted. As a single explanatory variable for Tulsa, the number of households per thousand populations was found to be as significant and as highly correlated to water consumption as per capita income. In Oklahoma City the statistic relating to households was significant, though not as highly correlated as other factors. Environmental factors were not found to be correlated to water use. This may be partly due to the inability to separate the various classes of water users within the category of total water use. (Moore-IVI)
W86-01765

6E. Water Law and Institutions

NORTH DAKOTA GARRISON DIVERSION PROJECT AND INTERNATIONAL ENVIRONMENTAL LAW,
Edinburgh Univ. (Scotland).
C. M. Carvell.
North Dakota Law Review, Vol. 60, No. 4, p 603-657, 1984. 308 Ref.

Descriptors: *North Dakota, *Garrison Diversion Project, *International law, *Canada, Legal aspects, Water resources development, Diversions, Water supply development.

The Garrison Diversion Unit (GDU) will divert water from the lake formed by Garrison Dam and Lake Sakakawea to central and southeastern North Dakota. The project is primarily intended to provide supplementary water supplies to 14 communities and 4 industrial areas and to provide for fish and wildlife conservation, recreation, and flood control. Furthermore, 250,000 acres are to be irrigated by the diverted waters. The GDU project has caused opposition based primarily on environmental considerations. On the whole, during this dispute, international law has been neglected even though its environmental concepts are relevant to the development of North Dakota's water project. A short review of the Garrison Diversion history is provided and the Canadian environmental objections to it. An overview is presented of two aspects of international law. First, substantive international environmental law is inspected. Second, a survey is made of international procedural law relevant to an activity having possible harmful effects of an international drainage basin. The conformity of the United States with this substantive and procedural law is reviewed. (Baker-IVI)
W86-01682

WATERS AND WATER COURSES - TORTS - OWNERS OF PROPERTY DAMAGED BY UNLAWFUL DITCHING OR UNREASONABLE DISCHARGE OF WATERS MAY OBTAIN RELIEF BY STATUTE OR BY THE TORT CONCEPT OF REASONABLE USE,
J. G. Golembeck.
North Dakota Law Review, Vol. 60, No. 4, p 741-749, 1984. 65 Ref.

Descriptors: *Water law, *Drainage, *North Dakota, *Torts, *Reasonable use, Legal aspects, Water rights, Surface waters, Civil law.

Several landowners in LaMoure County constructed a series of drainage ditches from the numerous natural ponds, soughs, and depressions on their land between 1967 and 1974. This activity caused water to deposit in a natural depression on plaintiff Young's land, causing, he charged, damage to his crops and farmland and decreasing the value of his farming operations. Three doctrines of surface water law are applicable. The oldest is civil law rule, which states that the owner of the highland or dominant estate has a natural easement or servitude in the low lying or servient estate, allowing the owner of the dominant estate to discharge all natural waters flowing or accumulating upon his land onto the land of the servient owner. The common enemy rule of surface water suggests a landowner may deal with surface water as he sees fit regardless of the effect on adjoining land. The common enemy rule encourages the full use and exploitation of land. A major flaw is that it forces adjoining landowners to bear the burden of surface water expulsion rather than the landowners who undertake the improvement projects. The reasonable use rule sets forth well defined guidelines including determinations of whether reasonable necessity requires the drainage and balancing the burden against the benefit of the drainage. As this particular case came to trial, it was noted that the plaintiff constructed dams on his own land, thus reducing the gravity of the harm. The trial court denied Young relief because his self-help measures were not legal under section 61-01-07. Moreover, the trial court stated that these self help measures in building dams also precluded Young from recovering under the reasonable use rule. The North Dakota Supreme Court stated that the statements of the trial court were based on an erroneous conception of the reasonable use doctrine. The court also noted that reasonable use should not be confused with negligence or contributory negligence. (Baker-IVI)
W86-01683

EFFLUENT REGULATION AND LONG-RUN OPTIMALITY,
University of Southern California, Los Angeles. Dept. of Economics.
D. F. Spulber.
Journal of Environmental Economics and Management, Vol. 12, No. 2, p 103-116, June, 1985. 1 Fig, 18 Ref.

Descriptors: *Public policy, *Regulations, *Effluents, Standards, Water pollution control, Economic aspects.

A regulator faced with free entry of firms is concerned not only with the implications of public policy for the discharges from a representative firm but also with the total pollution observed at the long run market equilibrium. The long run efficiency properties of regulatory instruments are examined in a multiple input framework. The effluent tax and tradeable permit are shown to be efficient with free entry and exit of small firms. The across-the-board effluent standard results in excessive entry and excessive industry pollution. The results of the study indicate the importance of directing public policy toward pricing the use of the environment. The policy instruments which achieve long run optimality in a competitive market with small firms are the effluent tax and the tradeable effluent permit. Direct intervention through output taxes or output controls, entry tariffs, or restrictions, or effluent constraints will create further distortions in the allocation of resources. Given an effluent charge or permit price equal to marginal social damages, the total of firm payments equals the sum of environmental rent and external damages. These two components provide optimal incentives for entry in the long run. (Baker-IVI)
W86-01684

MEASURING VALUES FOR ENVIRONMENTAL RESOURCES UNDER UNCERTAINTY,
New South Wales Univ., Kensington (Australia). School of Economics.
For primary bibliographic entry see Field 6A.
W86-01685

SOUTHERN OCEAN AND MARINE POLLUTION: PROBLEMS AND PROSPECTS,
George Washington Univ., Washington, DC. Dept. of Political Science.
For primary bibliographic entry see Field 6B.
W86-01686

KEEP YOUR POLLUTION TO YOURSELF: INSTITUTIONS FOR REGULATING TRANSBOUNDARY POLLUTION AND THE UNITED STATES-MEXICO APPROACH,
N. Glickman.
Virginia Journal of International Law, Vol. 25, No. 3, p 693-727, Spring, 1985. 188 Ref.

Descriptors: *Water pollution control, *International law, *United States, *Mexico, Water quality control, Water resources, Legal aspects, International agreements.

The variety of approaches to the control of transboundary pollution that have been tried around the world suggests that there is no simple solution to the ever-increasing international pollution problem. Nevertheless, the willingness of many countries to experiment with novel regulatory schemes bodes well for the future. Although the international law in this area is currently underdeveloped, as more countries submit themselves to specific and enforceable agreements there may well develop a body of customary international environmental law binding on all countries. Until that happens, however, transboundary pollution control will come about only through international agreement. A consideration of the different European and North American approaches to pollution regulation yields several important conclusions. First, that so many countries are beginning to involve themselves in transboundary pollution control represents a positive step in the effort to preserve and protect global natural resources. Second, the wide range of agreements signed in the past twenty years suggests an increasing awareness by the international community that pollution regulation should prevent disasters and not just respond to then. Third, the most effective agreements have been those that either specifically address a narrow problem, or provide a general framework for cooperation and establish procedures whereby the parties can develop solutions to narrow problems as they arise. (Baker-IVI)
W86-01688

HAZARDOUS WASTE CLEANUP: THE PRELIMINARIES,
Environmental Protection Agency, New York. Region II.
For primary bibliographic entry see Field 5G.
W86-01738

LAW OF THE COAST IN A CLAMSHELL; PART XIV: THE MARYLAND APPROACH,
San Francisco, California.
P. H. F. Graber.
Shore and Beach, Vol. 52, No. 1, p 3-10, January, 1984. 1 Fig, 94 Ref.

Descriptors: *Coastal waters, *Water rights, *Legal aspects, *Maryland, Public rights, Public access, Uplands, Tidal waters, Navigation, Erosion, Littoral zone.

As defined in the Maryland Coastal Management Program, the state's coastal zone embraces Baltimore City and 16 counties bordering the Atlantic Ocean, Chesapeake Bay and the Potomac River upstream from Washington, D.C. Coastal zone lands may be divided into uplands, tidelands and submerged lands. With some qualifications, Maryland follows the usual rule that property boundaries of lands adjoining tidal waters shift with those gradual, imperceptible physical changes termed accretion and erosion. Unlike courts in other coastal states, the Maryland Court of Appeals has not expansively applied the public trust doctrine, the concept dealing with the public's rights of navigation and fishing in tidal waters. However, the state's high court has recognized public rights in tide covered lands. Public access rights, private littoral rights, and the leasing and regulation of coastal zone lands and waters as currently practiced in Maryland are discussed. (Baker-IVI)

W86-01829

LAW OF THE COAST IN A CLAMSHELL; PART X: THE NORTH CAROLINA APPROACH,
California Dept. of Justice, San Francisco. Office of the Attorney General.
For primary bibliographic entry see Field 2L.
W86-01833

LAW OF THE COAST IN A CLAMSHELL; PART XV: THE SOUTH CAROLINA APPROACH,
For primary bibliographic entry see Field 2L.
W86-01836

LAW OF THE COAST IN A CLAMSHELL; PART XVI: THE MAINE APPROACH,
For primary bibliographic entry see Field 2L.
W86-01838

LAW OF THE COAST IN A CLAMSHELL; PART XVII: THE CONNECTICUT APPROACH,
For primary bibliographic entry see Field 2L.
W86-01840

LAW OF THE COAST IN A CLAMSHELL; PART XVIII: THE VIRGINIA APPROACH,
For primary bibliographic entry see Field 2L.
W86-01842

6F. Nonstructural Alternatives

GOVERNMENT SUBSIDIES FOR POLLUTION CONTROL INVESTMENTS - DO OTHER COUNTRIES ENJOY AN UNFAIR ADVANTAGE,
Environmental Resources Ltd., London (England).
R. Bidwell.
Chemistry and Industry, Vol. 85, No. 12, p 395-402, June, 1985. 2 Fig, 6 Tab, 3 Ref.

Descriptors: *Water pollution control, *Political aspects, *Investment, Economic aspects, Subsidies, Industries, Costs, Taxes.

A study was conducted to survey and assess the extent to which government subsidies are made available to industry for pollution control investments in selected countries; to assess the impact that these subsidies have on the net cost to industry of pollution control investments; to assess the extent to which the subsidy schemes conform to the European Community recommendation of 1975; taking account of possible financial assistance, and to determine whether there is evidence that environmental subsidies significantly distort competition. The study identified 36 schemes which might be used to assist industry with pollution control investments. Twenty-eight of these were specifically designed to provide aid for pollution control investments. Four of the schemes focus on particular industry sectors or groups of firms; a number of the schemes focus on particular geographical areas. Eight of the schemes identify research and development as one of their objectives or as their principal objective. Eight schemes were identified that provided general investment aid. These are schemes such as the UK regional allowance or general investment tax allowances that could be used to benefit industrial pollution control investments but which are not specifically designed for that purpose. Pollution subsidies available in the four continental European countries studied, The Netherlands, Italy, Germany, and France, in most cases were designed to assist existing firms with the investment cost of their pollution control plants. The UK does not offer environmental aid of this type. It does make available tax allowances on new investment amounting to around 14%. These environmental assistance schemes are undoubtedly of considerable benefit to firms required to comply with pollution control measures. (Baker-IVI)
W86-01612

6G. Ecologic Impact Of Water Development

FACTORS INFLUENCING THE SALINITY REGIME OF LAKE PONTCHARTRAIN, LOUSISANA, A SHALLOW COASTAL LAGOON: ANALYSIS OF A LONG-TERM DATA SET,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
W. B. Sikora, and B. Kjerfve.
Estuaries, Vol. 8, No. 2A, p 170-180, June, 1985. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake Pontchartrain, *Louisiana, *Salinity, *Canals, Water resources development, Environmental effects, Flow discharge, Lagoons.

Lake Pontchartrain is a brackish water lagoon in southeastern Louisiana. Numerous chemical and physical changes have resulted in this region due to the expansion of the city of New Orleans. The greatest potential for change in the lake arose from the completion of the Mississippi River-Gulf Outlet deep water canal in 1963. While a large increase in salinity of the lake waters was expected, less than half the expected increase actually occurred. The most important factor controlling salinity variations in the lake is discharge. Seventy-four percent of low frequency salinity variations are explained by freshwater discharge and the completion of the deep water canal. Annual variations of salinity are somewhat high in the lake. There has been a die back of freshwater swamps and a retreat of lagoon shorelines, but these are not felt to be a result of the deep water canal completion. (Baker-IVI)
W86-01335

NILE INSIDE THE SUDAN - INCREASING DEMANDS AND THEIR CONSEQUENCES,
King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.
For primary bibliographic entry see Field 6D.
W86-01377

CHEMICAL ZONATION IN GROUNDWATER OF THE CENTRAL PLAINS, CANTERBURY,
North Canterbury Catchment Board, Christchurch (New Zealand).
For primary bibliographic entry see Field 5B.
W86-01387

IMPACT OF RIVER CHANNELIZATION; IV. THE ECOLOGICAL EFFECTS OF CHANNELIZATION,
Welsh Water Authority, Nelson. South East District.
M. P. Brooker.
Geographical Journal, Vol. 151, No. 1, p 63-69, March, 1985. 1 Fig, 56 Ref.

Descriptors: *Channeling, *Environmental effects, *Rivers, *United Kingdom, *Channelization, Wildlife, Vegetation, Fish, Invertebrates, Birds.

River corridors (the channel and the immediate local environment) form one of the major linear habitats in the United Kingdom and sustain important wildlife resources. Channelization can result in changes which effect the in-stream and bankside ecology. In general, fish populations are severely affected by channelization, natural channels supporting higher densities, greater biomass and more species, and any recovery is usually slow. The response of macroinvertebrates to channelization is variable but recovery is often rapid. Aquatic vegetation forms an intimate part of the ecology of rivers and streams yet the effects of channalization on in-stream vegetation are poorly documented. Channelization often devastates bankside tree and ground cover. Channelization has a direct impact on riverine birds and, where such works are related to land drainage schemes, changes in water status of the catchment and subsequent land use substantially reduce areas available to breeding and wintering wetland birds. There is a need to describe, more fully, wildlife resources in river corridors, both instream and bankside, and to explore their relationships with habitat features in order to provide scientifically robust management recommendations designed to mitigate the effects of channelization. (Baker-IVI)
W86-01404

EFFECTS OF DREDGING OPERATIONS ON NUTRIENT AND SUSPENDED SEDIMENT CONCENTRATIONS,
Army Engineer District, New York.
For primary bibliographic entry see Field 5B.
W86-01563

LAKE GREVELINGEN: FROM AN ESTUARY TO A SALINE LAKE. AN INTRODUCTION,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
B. A. Bannink, and J. H. M. Van der Meulen.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 179-190, December, 1984. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Ecosystems, *Saline lakes, *Lake Grevelingen, *Netherlands, Water quality, Environmental effects, Water resources development, Eutrophication, Nutrients, Algae, Denitrification.

In 1972 an ecosystem study was started, mainly aiming at an analysis of the cycle of organic matter in the new evolving saline Lake Grevelingen, a former estuary, closed for reasons of flood prevention in 1971. The changing environmental conditions are described. Nitrogen and silica apparently limit phytoplankton primary production. A competitive interaction for nutrients between phytoplankton and microphytobenthos has been postulated. Nitrogen appeared to be the key factor in the aquatic system, assuming a denitrification rate of 3 to 4 g N/sq m/a. Long term observations indicate a slow eutrophication process during the period 1977-1980. Studies on population dynamics of dominant species and food-chain dynamics indicate a changing aquatic ecosystem with low predictability. (Baker-IVI)
W86-01567

PHYTOPLANKTON AND NUTRIENT DYNAMICS IN SALINE LAKE GREVELINGEN (SW NETHERLANDS) UNDER DIFFERENT HYDRODYNAMICAL CONDITIONS IN 1978-1980,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
C. Bakker, and I. De Vries.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 191-220, December, 1984. 11 Fig, 3 Tab, 32 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Hydrodynamics, *Lake Grevelingen, *Netherlands, Saline lakes, Silicon, Nitrogen, Primary productivity, Estuarine environment, Biomass, Flagellates, Seasonal variation.

Hydrographical and phytoplankton biomass parameters were studied in Lake Grevelingen, stressing the period of 1978-80. Clear salinity stratifications were observed during periods of flushing with North Sea water. This phenonenon was accompanied by strong gradients of water temperature, oxygen content, pH, silicon- and ammonium-concentration. High nutrient concentrations resulted from release from the bottom sediments. Under stratified (water depth more than 4-5 m) conditions, minimum silicon fluxes of more than 100 mg Si/sq m/day were estimated. The phytoplankton assemblage of Lake Grevelingen represents an impoverished version of the neritic community of the Southern Bight of the North Sea and of the Eastern Scheldt estuary. In summer it consists mainly of diatoms; some flagellates dominate in spring. The availability of silicon in spring was not correlated with the increase of planktonic biomass, because cryptomonad flagellates dominated during that period. The phytoplankton biomass may have been limited by silicon and nitrogen during summer. Some diatom species changed their morphological appearance, showing a more delicate

structure in Lake Grevelingen than in the tidal estuary of the Eastern Scheldt. The hydrodynamic changes in Lake Grevelingen, as a consequence of the functioning of the sluice in the closing dam with the North Sea, markedly influenced the environmental factors controlling species composition, biomass and productivity of the phytoplankton. Under semi-stagnant conditions in 1980 biomass values declined strongly but primary productivity even rose to a higher level. This indicates that the pelagic compartment of the lake was still far from stable. The highly productive phytoplankton assemblage, growing under limiting nutrient conditions in summer, was based on low biomass values and evidently underwent rapid processes of elimination of biomass. (Baker-IVI)
W86-01568

NUTRIENT CYCLING AND ECOSYSTEM BEHAVIOUR IN A SALT-WATER LAKE,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01569

PHYTOPLANKTON PRIMARY PRODUCTION IN BRACKISH LAKE GREVELINGEN (SW NETHERLANDS) DURING 1976-1981,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01570

CHANGES OF SEDIMENT DISTRIBUTION PATTERNS IN LAKE GREVELINGEN, AN ENCLOSED ESTUARY IN THE SW NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01571

SEDIMENT-WATER EXCHANGE IN LAKE GREVELINGEN UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01572

TRADING 404 PERMITS FOR ENHANCED FISH HABITAT,
S. E. Clyde.
Natural Resources and Environment, Vol. 1, No. 1, p 37-41, Winter, 1985.

Descriptors: *Negotiations, *Environmental effects, *Water resources development, *Bonneville Unit, *Central Utah Project, Water supply development, Irrigation, Water supply, Fisheries, Planning, Governmental interrelations.

The controversy over the loss of fish habitat in the Bonneville Unit of the Central Utah Project has a long history. The plan report to Congress in 1964 called for the development of about 315,000 acre ft of water for municipal and industrial use and some irrigation use. Transbasin diversions proposed would deplete the flows of nine streams resulting in the loss of fish habitat. The Army Corps of Engineers reviewed the permit application, and declined to issue a permit to construct the Vat diversion dam because of opposition from the Forest Service, the Fish and Wildlife Service, EPA, and the Utah Division of Wildlife Resources because of concerns over the amount of water for fishery releases. The repayment contract only allowed for fishery releases of 6,500 acre-ft of water, while the Forest Service demanded annual releases of 39,000 acre-ft of water, and fish and wildlife groups demanded that 44,000 acre-ft of water be released. The various parties finally entered into serious negotiations. A compromise agreement was reached which would provide 44,000 acre-ft of water annually for stream fisheries during the construction of the Strawberry Aqueduct and Collection System. After Strawberry Reservoir is filled, the agreement provides for 22,300 acre-ft of water and an additional 15,800 acre-ft to be acquired or developed through conservation, modification of deliveries, and through the acquisition of existing water rights. The state and federal agencies agreed to use their resources to acquire an additional 22,100 acre-feet. As a result of the compromise the permits were issued, and the project has been allowed to go forward. (Baker-IVI)
W86-01681

WATER QUALITY EFFECTS OF CLEARCUTTING UPPER COASTAL PLAIN LOBLOLLY PINE PLANTATIONS,
Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
D. C. McClurkin, P. D. Duffy, S. J. Ursic, and N. S. Nelson.
Journal of Environmental Quality, Vol. 14, No. 3, p 329-332, 1985. 3 Tab, 12 Ref.

Descriptors: *Clear-cutting, *Forest management, *Pine trees, *Water quality, *Environmental effects, *Tennessee, Nitrogen, Phosphorus, Potassium, Nutrients, Soil types.

The effect of clearcutting loblolly pine (Pinus taeda L.) on concentrations of sediment and nutrients in stormflows was studied on small cathchments near Lexington, TN. The plantation were established on eroded and abandoned agricultural lands with fragile soils. Soil series on the catchments include Lexington silt loam (fine-silty, mixed thermic Typic Paleudalfs), Providence silt loam (fine-silty, mixed, thermic Typic Fragiudalfs) and Ruston sandy loam (fine-loamy, silicious, thermic Typic Paleudults). Eight catchments (0.17-0.56 ha) were instrumented with flumes equipped with water stage recorders to measure stormwater and Coshocton wheel samplers to obtain integrated samples of the flow. Plantations on four catchments were clearcut; the other four were left as uncut controls. Stormflow samples were analyzed for sediment total Kjeldahl nitrogen (TKN) and total phosphorus (TP) and solution-phase TKN, TP, and potassium (K). Results indicated that a third or more of the TKN and two-thirds of the TP exported in stormflow from the catchments was via sediment. Solution-phase TKN and TP concentrations in storm-flow were similar on clearcut and control catchments. Solution K concentrations were consistently higher from clearcut catchments. Rainfall inputs of TKN, TP, and K exceeded stormflow losses. The study demonstrated that pine plantations established on fragile soils can be clearcut without significant impact on water quality if recommended practices are used. (Author's abstract)
W86-01705

CAN WE SAVE THE OGALLALA,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-01737

PERSISTENCE OF STREAM FISH ASSEMBLAGES: EFFECTS OF ENVIRONMENTAL CHANGE,
University of Southern Mississippi, Hattiesburg. Dept. of Biology.
S. T. Ross, W. J. Matthews, and A. A. Echelle.
American Naturalist, Vol. 126, No. 1, p 24-40, July, 1985. 3 Fig, 5 Tab, 60 Ref.

Descriptors: *Fish behavior, *Fish populations, *Environmental quality, *Brier Creek, *Oklahoma, Drought, Temperature effects, Water stress, Brier Creek, Oklahoma, Piney Creek, Arkansas.

Fish assemblage stability and persistence are contrasted in an intermittent, prairie-margin stream (Brier Creek, Oklahoma) and a permanent upland stream (Piney Creek, Arkansas). The duration of the study encompassed three to four turnovers in the populations of most of the species studied and a major environmental perturbation in Brier Creek. Knowledge of temporal stability and persistence of ecological communities is critical to an understanding of the importance of biotic interactions in the maintenance of community structure. Persistence, as indicated by present data, was high for both stream assemblages over approximately one decade. Assemblage stability, as determined from measures of abundance, indicated greater change in the overall fish fauna of Brier Creek than that of Piney Creek. Southeastern Oklahoma had a severe summer drought in 1980 resulting in heat death of fishes in Brier Creek. Although some species were transiently affected, the harsh summer did not have a lasting effect on the Brier Creek fish assemblage overall. Upstream stations subjected to regular summer drying showed greater variability in numerical species ranks within a characteristic suit of upstream species, compared with downstream stations. Station-level changes in both Piney and Brier creeks were significant in several cases, even though the overall fauna of the former did not change significantly in species-abundance ranks. Geographic scale may have had a major effect on the assessment of assemblage stability and persistence. In the absence of detailed knowledge of home ranges of component species, an assessment of assemblage stability should be based on at least several localities within a watershed. (Baker-IVI)
W86-01756

ABUNDANCE OF WEST INDIAN MANATEES (TRICHECHUS MANATUS) AROUND SELECTED FLORIDA POWER PLANTS FOLLOWING WINTER COLD FRONTS, 1982-1983,
Eckerd Coll., St. Petersburg, FL. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-01758

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,
Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
D. W. Davis.
Shore and Beach, Vol. 51, No. 4, p 30-39, October, 1983. 5 Fig, 71 Ref.

Descriptors: *Wetlands, *Erosion, *Louisiana, Economic aspects, Social aspects, Fishing, Hunting, Recreation, Land use, Farming, Oil industry, Environmental effects, Flood control structures, Drainage.

Louisiana's coastal zone is presently out of balance - a great natural catastrophe is occurring. Land is disappearing. For the entire Louisiana coast, marsh losses in 1980 exceeded 25,000 acres per year. Land building in the deltaic plain has been replaced by a projected rate of loss of approximately 40 sq mi/yr. The land that is eroding at a record rate is a result of sediment deposition associated with the Mississippi River. The construction of flood levees and the dredging of drainage, navigation, petroleum and logging canals upset the sedimentation balance, influence saltwater intrusion and disrupt the natural flow regimes. Landloss forces now supersede constructive forces, thus threatening the jobs, industries and lifestyles of people whose lives are tied directly or indirectly to the coast. Trapping (a multimillion dollar industry), fishing, shrimp harvesting, the oyster industry, menhaden landings, and even recreational use of the waters are threatened. Movement from agricultural ventures to oil industry along the coastal line has brought with it changes in the erosional aspect of the coastal lands. (Baker-IVI)
W86-01835

BIOLOGICAL IMPACTS ON BEACH REPLENISHMENT AND BORROWING,
Coastal Engineering Research Center, Fort Belvoir, VA.
E. J. Pullen, and S. M. Naqvi.
Shore and Beach, Vol. 51, No. 2, p 27-31, April, 1983. 1 Fig, 32 Ref.

Descriptors: *Shoreline, *Beach replenishment, *Environmental effects, Great Lakes, Sand, Benthic animals, Corals, Turtles, Habitats, Fish, Lake shores, Habitats, Dredging.

Shore erosion is a major problem along many ocean beaches and the shoreline of the Great

Lakes. The Corps of Engineers replenishes and nourishes eroding beaches by pumping sand onto the beach. Beach replenishment creates a new habitat that is uninhabited by benthic animals, except for those that may have survived being pumped to the beach with the replenishment sediments or those that survived by vertical migration through deposited sediments. Timing of the replenishment operation may also be a critical factor in reestablishment of benthic animals. Adjustment of benthic animals to replenishment is generally expected since the animals are accustomed to natural disturbances and have demonstrated the ability to recover rapidly. Corals pose a special problem along replenished beaches in Florida. The mobility of fish and some invertebrates render them less vulnerable to the adverse effects of beach replenishment than the nonmotile benthic communities. Destruction of habitat rather than suspended sediment seems to be greater potential problem to fish. Moderate to complete recovery of motile animals will usually occur within less than a year unless a required habitat or food source is permanently lost. Sea turtles are one of the most vulnerable motile vertebrate animals to the effects of beach replenishment. The major physical impact of dredging borrow material is the mechanical disturbance of the substrate and the subsequent redistribution of suspended sediments and turbidity. Potentially, the most serious impacts of offshore dredging are the loss or damage to major commercial species of benthic shellfish, seagrass beds, and corals. Repopulation of a dredged area by benthic animals will depend on the magnitude of the disturbance, the new sediment interface, and the water quality in the borrow pit. (Baker-IVI)
W86-01844

7. RESOURCES DATA

7A. Network Design

LAKE ERIE NUTRIENT LOADS, 1970-1980,
Corps of Engineers, Buffalo, NY. Lake Erie Wastewater Management Study.
For primary bibliographic entry see Field 5G.
W86-01344

CORBICULA FLUMINEA (MOLLUSCA: PELECYPODA) AS A BIOLOGICAL INDICATOR OF HEAVY METALS IN THE KANAWHA RIVER, WV,
Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
J. E. Joy, A. J. Pritchard, and D. Danford.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 113-117, 1983. 8 Ref. Virginia Environmental Endowment grant 81-101.

Descriptors: *Clams, *Bioindicators, *Heavy metals, *Kanawha River, *West Virginia, Cadmium, Iron, Metals, Indicators, Zinc, Copper, Manganese.

Two hundred large (16 to 24 mm) Corbicula fluminea individuals were monitored for 10 heavy metals at four different sites (50 clams at each site) on the Kanawha River over a nine week period. Analysis of the viscera revealed silver in the smallest concentrations (between 0.1 and 0.2 micro-g/g) of the metals at all four sites. Cadmium was also found in low concentrations (between 0.2 and 0.4 micro-g/g). Iron was found in the highest concentrations, in some cases surpassing 500 micro-g/g. Magnesium levels were also high, generally ranging between 100 and 200 micro-g/g at all sites. Concentrations of zinc were interesting because of their virtually unchanging levels (approximately 30 micro-g/g) at all four sites over the nine weeks. Copper concentrations were also very constant (between 7.0 and 9.0 micro-g/g) at all sites with the exception of weeks 7 and 9 at Marmet when copper levels reached 17.0 and 12.0 micro-g/g, respectively. While generally low, chromium levels were quite variable, ranging from 0.5 micro-g/g at London, to a high of 12.0 micro-g/g at Glen Ferris. Manganese levels were also quite variable, ranging from a low of 9.2 micro-g/g at Winfield to a high of 100 micro-g/g at London. (Author's abstract)
W86-01596

HETEROTROPHIC BACTERIA IN WATER DISTRIBUTION SYSTEMS. II. SAMPLING DESIGN FOR MONITORING,
Centre des Sciences de l'Environment, Metz (France).
For primary bibliographic entry see Field 5F.
W86-01915

7B. Data Acquisition

EVALUATION ON POLLUTION IN THE XIANG JIANG RIVER BY USING ZOOBENTHOS,
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
L. Baoyuan, W. Shida, and H. Deliang.
Acta Hydrobiologica Sinica, Vol. 8, No. 2, p 225-236, May, 1984. 3 Fig, 7 Tab, 11 Ref.

Descriptors: *Water pollution, *Bioindicators, *Zoobenthos, *Xiang Jiang River, China (Peoples Republic), Species diversity, Mayflies, Indicators, Water pollution effects.

Studies on zoobenthos in the Xiang Jiang River were carried out five times between July, 1980 and December, 1981. Artificial substrate was used for sampling in all stations in the river, especially the heavily polluted area between Zhuzhou and Xiangtan. Based on the data obtained from the survey, the Shannon diversity index was calculated and used for the biological evaluation of water quality of the river. The relationship between the number of zoobenthos and the chemical content was also calculated in some stations. Results show that the mayfly naiads are more sensitive to heavy metals and pesticides and may be used as monitors for water pollution in the river. The percentage of ephemeropterans and trichopterans as compared with that of the other aquatic insects used for water monitoring was also determined. In nearly all stations the diversity indices were more than 2.11, except the Xiawan station, where the index was only 0-0.73. (Author's abstract)
W86-01323

HABITAT REQUIREMENTS AND BIOINDICATOR VALUE OF THE MAIN COMMUNITIES OF AQUATIC VEGETATION IN NORTH-EAST POLAND,
Warsaw Univ. (Poland). Dept .of Phytogeography.
For primary bibliographic entry see Field 2H.
W86-01326

EFFECTS OF EFFLUENT OF MUNICIPAL WASTEWATER ON THE GROWTH OF PORPHYRA YEZOENSIS IN THE CASE OF STATIC CULTURE (IN JAPANESE),
Tokyo Univ. of Fisheries (Japan).
For primary bibliographic entry see Field 5C.
W86-01363

SLEEVE AND CASING LYSIMETERS FOR SOIL PORE WATER SAMPLING,
Wisconsin Univ.-Madison. Dept. of Soil Science.
R. Morrison, and J. Szecsody.
Soil Science, Vol. 139, No. 5, p 446-451, May, 1985. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Lysimeters, *Pore water, *Water sampling, *Sleeve lysimeters, *Casing lysimeters, Particle size, Monitoring wells, Wells.

Two pore water samplers were designed for the purpose of incorporating a lysimeter into the casing of a monitoring well and to provide multiple sampling capabilities in a single retrievable section. A sleeve lysimeter was fabricated for use with a monitoring well and provided multiple sampling points to depths of about 15 m. The casing lysimeter provides multiple sampling points to depths in excess of 15 m by incorporating several lysimeters with threaded PVC well casing. The minimum vertical distance between the porous sections of two lysimeters was calculated using a linearized solution of the matric potential and steam functions for various soils at finite and infinite depths. A vertical spacing not less than 20 times the lysimeter radius (20 r sub 0) is appropriate for most soils. The radius of sampling influence is maximized if the borehole diameter is only slightly larger than the lysimeter, and a fine-grained silica flour (grain size 0.032 mm) is used for an optimum backfill around the porous section of the lysimeter. (Author's abstract)
W86-01422

DESIGN OF A SENSITIVE AND PRACTICAL CLOSED-TOP INFILTROMETER,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
For primary bibliographic entry see Field 2G.
W86-01423

IRRIGATION SCHEDULING USING CROP INDICATORS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. J. Reginato, and J. Howe.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 125-133, June, 1985. 5 Fig, 24 Ref.

Descriptors: *Irrigation scheduling, *Water stress, *Plant physiology, Soil water, Cotton, Canopy temperature, Petioles, Crop yield.

Plant stress utilizing crop temperature under field conditions may be quantified utilizing a crop water stress index (CWSI). Petiole water content and canopy temperature of cotton were used as indicators of stress in cotton. Air temperature was defined as the value obtained with an aspirated sling psychrometer at the time canopy temperaure was measured each afternoon. Canopy temperatures were taken daily about an hour past solar noon, four looking east and four looking west, down the rows. Solar radiation was measured with a silicon sensor each minute and integrated into an hourly basis, ultimately yielding daily totals. Petiole water content was measured daily by weighing petioles and determining the weight difference after being oven dried for 24-hrs. Crop yield was obtained from each plot using a standard cotton picker. A CWSI using remotely sensed canopy temperature was a better indicator of plant stress than was petiole water content. This point was most evident when using these parameters as a potential tool for scheduling irrigations and for estimating lint cotton yield prior to harvest. Petiole water content does not possess the sensitivity of a CWSI for assessing crop stress. PWC involves a labor intensive destructive plant sampling procedure which yields data for a single plant part, whereas a CWSI is derived from a measurement that surveys many plants. For a rapid assessment of crop stress to schedule irrigation and estimate yield, it seems appropriate to use the CWSI. (Collier-IVI)
W86-01433

THERMAL INFRARED DETECTION OF SUBMARINE SPRINGS ASSOCIATED WITH THE PLYMOUTH LIMESTONE,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2F.
W86-01443

UPTAKE AND RELEASE OF SOME TRACE METALS BY AQUATIC BRYOPHYTES IN ACIDIFIED WATERS IN SCOTLAND,
Freshwater Fisheries Lab., Pitlochry (Scotland).
L. A. Caines, A. W. Watt, and D. E. Wells.
Environmental Pollution (Series B), Vol. 10, No. 1, p 1-18, 1985. 10 Fig, 3 Tab, 24 Ref.

Descriptors: *Bryophytes, *Bioconcentration, *Bioindicators, *Trace metals, *Aluminum, *Acidity, *Scotland, *Loch Ard Forest, *Galloway, Indicators, Metals, Moss, Liverwort, Indicators,

Water pollution effects, Manganese, Zinc, Hydrogen ion concentration, Acid rain.

Bryophytes can be considered as thin sheets of largely undifferentiated cells in more or less intimate contact with their physical and chemical surroundings and therefor can reflect the chemical status of their environment. Aquatic bryophytes have been analyzed for aluminum, manganese and zinc to assess the feasibility of using these plants as bioindicators of metal loadings to acid streams and lochs in Loch Ard Forest (30 km N of Glasgow) and the Galloway area of southwest Scotland. Special care was taken in sample preparation to remove all extraneous mineral particles from the liverwort and moss samples. Bioconcentration occurred in all waters but increased hydrogen ion concentrations in the water were associated with decreased metal concentrations in the bryophytes. The interdependence between Al and H(+) concentration was demonstrated in the Loch Ard Forest stream water samples; the maximum concentration of Al in a stream with pH 6.62 was 25 micro-g/l compared with 400 micro-g/l in a stream with an annual mean pH of 4.43. The seasonal variation in Al concentration which occured in the most acid stream had a maximum concentration of 394 micro-g/l in February, which declined rapidly to 35 micro-g/l in May (1980); this sharp decrease coincided with a prolonged dry spell with low rainfall which resulted in a rise in stream pH and a greatly reduced leaching of Al from the catchment. Release of aluminum, manganese and zinc from the bryophytes by hydrogen ions may make a significant contribution to the loadings of these metals in acid waters. While the pH remains above 5.5, trace metals such as Al and Mn are taken up and retained by the bryophyte. At lower pH values this reservoir of metal ions may be released into the stream water. It is possible that a sharp drop in pH could release sufficient trace metals to exceed lethal thresholds for fish and other organisms. (Collier-IVI)
W86-01452

LONG-TERM STREAMFLOW OBSERVATIONS IN RELATION TO BASIN DEVELOPMENT,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 4C.
W86-01472

STUDY OF THE HYDROGEOPHYSICAL PROPERTIES OF FISSURED AQUIFERS USING A DOUBLE POROSITY MODEL,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
For primary bibliographic entry see Field 2F.
W86-01478

USE OF AERIAL PHOTOGRAPHY AND IMAGE PROCESSING TO MEASURE DYE DISPERSION FROM A LONG SEA OUTFALL,
Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
W. B. Wilkinson, and P. J. Curran.
Proceedings of the Institution of Civil Engineers, Vol. 79, p 327-348, June, 1985. 7 Fig, 9 Tab, 35 Ref.

Descriptors: *Aerial photography, *Image processing, *Dye dispersion, *Outfalls, Remote sensing, Effluents, Dye releases, Tracers, Wastewater disposal.

Aerial photography and image processing to measure dye dispersion was carried out as part of an extensive study to assess the performance of a 3500 m long sea outfall discharging off the south coast of England. A slug of Rhodamine WT dye was mixed with the sewage at the pumping station on the shore. The tracer emerging from the outfall's diffuser section and its subsequent dispersion in the sea was measured by boat survey and by aerial photography. The black and white aerial photographs were digitized and manipulated using a digital image processor so that the red reflectance of the dye could be correlated with the concentration of dye measured in the sea. A high level of correlation between red reflectance and the dye concentration was achieved. This correlation was then used as the basis for predictive mapping of dye concentration from other black and white aerial photographs, and detailed contours of dye concentration for a number of time frames were prepared. A high level of accuracy was obtained when the dye concentrations determined from the processed black and white aerial photographs were compared with direct measurements. (Author's abstract)
W86-01518

REPLACEMENT OF THE TELEMETRY SYSTEM OF THE SUNDERLAND AND SOUTH SHIELDS WATER COMPANY,
R. T. Heslop.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 231-237, June, 1985. 2 Fig.

Descriptors: *Telemetry, *Water conveyance, Water management, Water distribution, Planning, Automation, Monitoring, Water quality, Water treatment.

A telemetry system is described as it was applied to the Sunderland and South Shields Water Company which currently supplies 140 ml/d of water to a population of 554,000 in the 342 sq km area covering the coastal strip south of the river Tyne to just north of Hartlepool, England. Originally the 23 principal outstations were linked by rented land line omnibus circuits to the Company. The 25 minor outstations were linked to the nearest principal outstation by direct land line conveying data from the satellite in analogue form. Early proposals for the replacement of the master station involved the use of purpose-built computers designed by the telemetry manufacturer. The original intention was to retain the original outstations, but the cost of providing a special director unit required to enable original outstations to communicate via the omnibus circuits with the new master station was very high. Thus it was decided to replace the original hard wired outstations with CMOS equipment. The use of the telemetry system has long since progressed from the simple activity of monitoring. Presently the Company uses its central control functions and infomation in matters of waste prevention and efficient source utilization. Projected applications of the system are in the following areas: dynamic network analysis of the distribution network; waste location, assessment, and prevention; trunk main management; monitoring of flow meters, efficiency service intervals and optimized locations; pressure zoning and control; water quality distribution and zoning, including effects of system alterations on the processes of sensitive industrial consumers; complaints monitoring and management; control of use of fire hydrants; system chlorination control; discolored water preventive measures; control of animal infestation in mains; correlation of rainfall and hydrological data; pollution of souces; monitoring of groundwater well levels and correlation with source output; and groundwater source interaction and correlation. (Baker-IVI)
W86-01521

ASSESSING HABITATS USED BY WARM-WATER STREAM FISHES,
Illinois Natural History Survey, Champaign.
For primary bibliographic entry see Field 2H.
W86-01599

METHOD FOR LOCATING SEDIMENT ANOMALIES IN LAKEBEDS THAT CAN BE CAUSED BY GROUNDWATER FLOW,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2H.
W86-01667

STRIPPING ANALYSIS AND CHROMATOGRAPHIC SNIFFING FOR THE SOURCE IDENTIFICATION OF ODOROUS COMPOUNDS IN DRINKING WATER,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
R. Savenhed, H. Boren, and A. Grimvall.
Journal of Chromatography, Vol. 328, p 219-231, June, 1985. 4 Fig, 5 Tab, 27 Ref.

Descriptors: *Pollutant identification, *Organoleptic properties, *Stripping analysis, *Chromatographic sniffing, Odors, Water pollution sources, Water analysis.

Chemical and sensory methods have been combined into an improved technique for the source identification of odorous compounds in drinking water. A simple device for gas chromatographic sniffing, in which the capillary column is lead to the odor observer via heated copper tubing, has been developed. This system is highly sensitive and highly accurate for the determination of retention times. A stripping technique that permits high stripping temperatures without technical problems has also been developed, and it has been shown to increase significantly the number of odorous compounds detected by column sniffing. The design of the stripping system gives a very low blank level that results in almost no compounds detected on column sniffing of extracts from odor-free water. Odor profiles from a river basin with discharges from agriculture, industry and municipalities are presented. Special attention has been given to the effects of pulp mill discharge, and it is shown that they are mainly of local importance with regard to odorous compounds. (Author's abstract)
W86-01696

OPERATIONAL RANGES FOR SUCTION LYSIMETERS,
Kaman Tempo, Santa Barbara, CA.
For primary bibliographic entry see Field 2G.
W86-01697

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,
Woodward-Clyde Consultants, Santa Ana, CA.
G. A. Robbins, and M. M. Gemmell.
Ground Water Monitoring Review, Vol. 5, No. 3, p 75-80, 1985. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Vadose water, *Monitoring, *Pollution detection, *Aeration zone, Path of pollutants, Fate of pollutants, Waste disposal, Wells, Lysimeters, Vapor probes, Tensiometers, Conductivity.

Increasingly, regulations by federal, state and local agencies are being developed that require the installation of vadose zone monitoring systems for hazardous chemical facilities in addition to, or in lieu of, conventional groundwater monitoring wells. Compared to a ground water monitoring approach, vadose zone monitoring systems may permit earlier detection of chemical leakage and less costly cleanup of contamination. The effective use of vadose zone monitoring systems in detecting contamination dependes on many factors. Without proper consideration of these factors, a vadose zone monitoring system may not give as high a level of reliability as a groundwater monitoring system. Major factors to consider in installing a vadose zone monitoring system are: type of instrument to use, number of instruments, depths and location of instruments, and frequency of monitoring. Means to evaluate these factors in a comprehensive fashion have been lacking. Based on recent experience in installing and operating vadose zone monitoring systems, criteria and methods useful in resolving the preceeding factors have been developed. Types of instruments can be classified as either direct (lysimeter, vapor probe) or indirect (tensiometer, conductivity probe). A combination of the two is needed for reliability. The depth, location and number of instruments depend on the geometry of the facility, the number and size of likely contaminant leakage points in engineered barriers, properties of the material being monitored, the effective radius of monitoring for each instrument, vadose zone properties, and types of remedial actions that are available. The frequency of monitoring largely depends on the rate of movement of the contaminant. Evaluating the preceding

factors requires some level of modeling and preliminary field testing. (Author's abstract)
W86-01701

DETERMINATION OF INDIUM IN MINERALS, RIVER SEDIMENTS AND COAL FLY ASH BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITH PALLADIUM AS A MATRIX MODIFIER,
Academia Sinica, Beijing (China). Inst. of Environmental Chemistry.
X.-Q. Shan, Z.-M. Ni, and Z.-N. Yuan.
Analytica Chimica Acta, Vol. 171, p 269-277, 1985. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Indium, *Chemical analysis, *Electrothermal Atomic Absorption Spectrometry, *Atomic absorption, *Trace metals, *Sediments, *Fly ash, Palladium, Metals, Spectrometry.

Due to the low levels of indium found in minerals and rocks, analyses have depended on neutron activation and spark-source mass spectrometry. A method is described for the determination of indium (10-40 micro-g/g) in lead-zinc ores and magnetic pyrites. Graphite furnace atomic absorption spectrometry is used with palladium as a matrix modifier. Indium (down to 0.085 micro-g/g) in river sediments and coal fly ash can be determined after pre-extraction with ammonium iodide into 4-methyl-2-pentanone. The low sensitivity for indium was assumed to be due to the vaporization of molecular species of indium during the pre-atomization stages, and efforts were made to find suitable matrix modifiers which might prevent such a vaporization loss. Of several metal salts tested for this purpose, palladium was shown to be the best modifier, although all metals tested at least doubled the sensitivity. The indium absorbance in the absence of matrix modifier obtained after ashing at 600 C was used as a baseline against which the enhancement properties were measured. In the presence of palladium, the maximum tolerable ashing temperatures for indium in aqueous solution or organic extract can be raised to 1200 C or 1000 C, respectively. The sensitivity is improved by a factor of three compared to that obtained for pure aqueous indium solutions. It is assumed that the addition of palladium stabilizes indium by forming more thermostable compounds or alloys and decreases the formation of volatile species such as InO, thus enhancing the atomic absorbance. (Collier-IVI)
W86-01718

DISCRIMINATION OF SOIL PHYSICAL PARAMETERS, THERMAL INERTIA, AND SOIL MOISTURE FROM DIURNAL SURFACE TEMPERATURE FLUCTUATIONS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2G.
W86-01772

APPROXIMATE ANALYSIS OF THE BOREHOLE PERMEAMETER IN UNSATURATED SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W86-01774

INSTRUMENT FOR MEASURING THE AVERAGE STOMATAL CONDUCTANCE OF CONIFER SEEDLINGS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
For primary bibliographic entry see Field 2I.
W86-01782

SET OF REMOTE-SENSING APPARATUS FOR QUICK METHODS OF HYDROLOGIC OBSERVATIONS ON INLAND WATER BODIES,
Limnologeskii Inst., Moscow (USSR).
G. V. Druzhinin, V. M. Ivanov, O. E. Korotkevich, A. M. Kryuchkov, and V. B. Rumyantsev.
Water Resources, Vol. 11, No. 3, p 273-280, May-June, 1984. 5 Fig, 15 Ref. Translated from Vodnye Resursy, No. 3, p 147-154, May-June, 1984.

Descriptors: *Water quality, *Monitoring, *Remote sensing, Water quality control, Evaluation, Measuring instruments, Computers.

One of the most important problems of monitoring inland water bodies is to obtain a prompt determination of the water quality. Quick methods of observation are needed by means of which the actual state of water masses, elements of their dynamics, presence of wastewaters in water bodies, routes of their spreading, and other parameters can be determined. A set of remote-sensing apparatus meeting these indicated requirements has been developed and is undergoing testing. A description is given of the various parts of the system including the resistance thermometer, conductometer, oximeter, water transparency meter, and the meter used to determine the depth of submergence of the group of sensors. Further improvements are expected to be accomplished by increasing the number of measured physical and chemical characteristics through the addition to the set of new sensors for a more reliable identification of water masses in the basin and through the conversion of the recording of the measured parameters to a form convenient for input into a computer and also the possibility of transmitting the information over a radio channel. The solution of these problems will considerably increase the promptness of monitoring water bodies. (Baker-IVI)
W86-01828

RADIO-TELEMETRY AS AN AID TO ENVIRONMENTAL CONTAMINANT EVALUATION OF MOBILE WILDLIFE SPECIES,
Battelle Pacific Northwest Labs., Richland, WA.
L. E. Eberhardt, and L. L. Cadwell.
Environmental Monitoring and Assessment, Vol. 5, No. 3, p 283-289, September, 1985. 2 Fig, 17 Ref. DOE contract DE-AC06-76RLO 1830.

Descriptors: *Telemetry, *Wildlife, *Radioactive wastes, Remote sensing, Monitoring, Radioactive waste disposal, Waste ponds, Ducks, Deer, Hanford, Washington.

Programs monitoring wildlife species for environmental contaminants from localized sources can maximize the amount of information obtained from an individual animal by using radio-telemetry to ascertain residence history. The use of radio-telemetry techniques on two mobile wildlife species, mule deer (Odocoileus hemionus) and mallard ducks (Anas platyrhynchos), to document their use of and movement from low-level radionuclide contaminated waste ponds are described. The study was conducted on or near two man-made waste management ponds located approximately in the center of the Hanford Site in southcentral Washington. Both ponds, which now support dense stands of aquatic and riparian species, receive effluent water from chemical and waste processing plants associated with the nuclear facilities. Radiotelemetry techniques provided the opportunity to ascertain the residence history of highly mobile wild animals and to select those few individuals for sampling that have a known residence history within the area of interest. Radio-telemetry techniques can provide data on the extent, direction or location, and seasonality of movement by mobile wildlife species that may aid in interpreting potential impact to consumers (man) from ingestion pathways. (Moore-IVI)
W86-01886

COMPARISON OF THREE FIELD METHODS FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 2G.
W86-01909

7C. Evaluation, Processing and Publication

COMPUTER AIDED MAPPING PROJECT AIDS SEVERN TRENT,
For primary bibliographic entry see Field 6A.
W86-01631

CALCULATING WITH MICROCOMPUTERS,
For primary bibliographic entry see Field 6A.
W86-01632

GROUND-WATER RESOURCES OF TOWNER COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01917

8. ENGINEERING WORKS

8A. Structures

NOTE ON THE SHAPES OF FLEXIBLE DAMS,
University of Manchester Inst. of Science and Technology (England).
R. Watson.
Journal of Hydraulic Research, Vol. 23, No. 2, p 179-194, 1985. 19 Fig, 1 Tab, 11 Ref.

Descriptors: *Dam design, *Flexible dams, Dam construction, Inflatable dams, Temporary structures.

Flexible dams are in use as both temporary and permanent structures in a number of countries. The types considered here are usually constructed of a textile fabric heavily impregnated and covered wth a synthetic rubber. The inflatable variety is more common and consists of a sheet of fabric anchored to the channel bed at two edges and inflated with either air or water. Tension in water inflated dams is usually rather higher but, in many cases, they are easier to operate. Some properties of completed dams are examined. These include the product of tension per unit width and fabric length - the latter being roughly proportional to the cost of the material. Also shown are the fabric lengths, the volume enclosed, the base length and the total perimeter. The change of shape of a dam during inflation with water or with air is discussed. The information provided should help to clarify the mechanics of inflatable dams and allow suitable dam shapes to be designed to fit any required static conditions and their behavior during inflation predicted. (Baker-IVI)
W86-01394

ROCKBURST DRAMA IN NORTHERN INDIA,
Bhakra Dam (India).
R. K. Malhotra.
Tunnels and Tunnelling, Vol. 17, No. 4, p 32-34, April, 1985. 4 Fig, 1 Tab.

Descriptors: *Tunnels, *Rockbursts, *Construction, *India, *Beas-Satluj Link Project, Rocks, Mass wasting, Rock mechanics, Geological fractures.

Problems encountered during the excavation of two pressure tunnels, involving 25.55 km of tunnelling, in the gigantic inter-river basin transfer Beas-Satluj Link Project in India are reviewed. The Project involved tunnelling through weak strata of the geologically young Himalayan ranges. Problems were manifold due to encountering incompetent strata with faults, shear zones, water-bearing crushed rock and pressure-exerting strata and secondly, as it was the first time that tunnels of such length and diameter were designed and excavated totally by Indian skill, there were problems caused by inexperience. In actual excavation, phyllites, quartzites and granites in relatively dry conditions, proved to be good tunneling media. In the granite reach, massive to moderately jointed granites con-

stituted 55% while the percentage of highly jointed to blocky granites came to about 30% with the saturated shear zones and highly kaolinized pockets making up the remaining 15%. While tunneling through weak geological formations, there were numerous incidents associated with rock bursts, convergence and shearing of steel supports leading to a virtual collapse of the heading. (Baker-IVI)
W86-01462

DEWATERING FOR THE WELL-BEING OF TUNNELLING,
M. Jones.
Tunnels and Tunnelling, Vol. 17, No. 5, p 46-48, May, 1985. 5 Fig.

Descriptors: *Tunnel construction, *Tunnels, *Groundwater management, *Wellpoints, Construction, Dewatering.

Groundwater control by wellpointing is a standard weapon in the armory of tunnelling engineers. Wellpointing is frequently employed in combination with other methods, whether simultaneously or at different stages of the same project. Where the amount of water is substantial, pumping from wells surrounding the excavation site is desirable as there is rarely enough room in the tunnel to install dewatering equipment of sufficient capacity. When used in conjunction with other methods of ground improvement, this can reduce materials consumption. Many factors considerably restrict the application of dewatering by wellpoints. Pump capacity, geological structure of the ground itself, permeability, and type of strata each affect the outcome. Wellpointing is mainly used with shallow excavations whether cut and cover or true tunnelling. When water bearing strata is expected during pipe jacking it is usual to work under compressed air. Dewatering by wells can frequently speed the completion of a tunnelling project. Specific examples of the use of these dewatering techniques are briefly considered. (Baker-IVI)
W86-01463

DYNAMIC ANALYSIS OF SHORT-LENGTH GRAVITY DAMS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Civil Engineering.
A. A. Rashed, and W. D. Iwan.
Journal of Engineering Mechanics, Vol. 111, No. 8, p 1067-1083, August, 1985. 7 Fig, 1 Tab, 19 Ref.

Descriptors: *Gravity dams, *Dam stability, *Dynamics, Dams, Mathematical equations, Reservoir water, Vibration, Compressibility, Ground motion.

A preliminary investigation of the dynamic behavior of short-length gravity dam reservoir systems is presented. A simplified and economical procedure for the dynamic analysis of such structures is developed, based on the Rayleigh-Ritz method and the substructure concept. The dam is modeled as a thick plate of uniform thickness, whose out of plane deformation is governed by a pure shear theory. The water in the reservoir is treated as a continuum, and its compressibility and the flexibiltiy of the reservoir floor and sides are taken into consideration. Neglecting water compressibility, free vibration analyses are performed on dams having different length-to-height ratios, with empty and totally full reservoir conditions. As expected, the natural frequencies are reduced in value due to the presence of water, and antisymmetric modes of vibration are developed. Compared to the two-dimensional case of infinitely long dams, the natural frequency of a dam increases in value as its length to height ratio decreases. A forced vibration analysis is carried out in the frequency domain, including water compressibility and flexibility of reservoir boundaries. Crest displacement and acceleration responses of dams with various length to height ratios to all three components of harmonic ground motion are obtained. The change in the length to height ratio significantly affects these frequency domain responses: a decrease in the value of B/D shifts the resonant frequencies to the right, and alters the resonant amplitudes. Also, the transverse component of ground motion contributes a small amount to the dam response, as compared to the longitudinal component contribution, while the vertical component contributes a significant amount. (Baker-IVI)
W86-01529

COMPACTION CHARACTERISTICS OF RIVER TERRACE GRAVEL,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W86-01532

WAYS TO IMPROVE THE TECHNOLOGY OF CONSTRUCTING CONCRETE HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8F.
W86-01622

STABILITY OF THE ZHITOMIR CELLULAR BUTTRESS DAM,
V. I. Zeryukov, and S. I. Karlin.
Hydrotechnical Construction, Vol. 18, No. 11, p 533-537, November, 1984. 4 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 15-18, November, 1984.

Descriptors: *Abutments, *Butress dams, *Dam stability, Overflow dams, Cellular construction, Reinforced concrete, Dam construction, Monitoring.

The Zhitomir overflow dam, constructed in 1962-1965 on the Teterev River on the western outskirts of Zhitomir city, has been in operation for more than 15 years. The hydraulic structures include a precast reinforced-concrete overflow cellular buttress dam with a standard-shaped head, abutments, and a 1-m-diameter dewatering pipe outlet enclosed in the left-bank abutment. Ten cracks were found in the abutments, of which 8 were in the right-bank abutment and 2 in the left-bank abutment. Visual inspections of the Zhitomir overflow dam in 1980 showed that during its operation the negligible cracks that appeared have not affected the strength of the structure. As a rule, all cracks were due to temperature effects. In order to improve monitoring of the condition of hydraulic structures, it is recommended that they be equipped with measuring instruments such as height markers and piezometers. (Keenan-IVI)
W86-01626

DESIGN CRITERIA FOR RESERVOIR BOTTOM OUTLETS,
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserbau.
H. Blind.
International Water Power and Dam Construction, Vol. 37, No. 7, p 30-32, July, 1985. 6 Fig.

Descriptors: *Design criteria, *Reservoirs, *Outlets, Drawdown, Dam construction, Reservoir operation, Dam design, Flood control.

Based on experience, the provision of a bottom outlet in a dam is generally necessary. The bottom outlet, in addition to serving the purpose of normal reservoir emptying, should be designed to provide adequate discharge capacity for operational conditions such as emptying the reservoir for emergency repair work. According to the requirements and limitations of the scheme, the capacity of a bottom outlet can vary considerably. If enough discharge structures are available, the capacity of the bottom outlet can be kept relatively small. An essential factor to consider is the desired time for emptying the dead reservoir storage. Should large discharge structures be available, it will be necessary to install a very efficient bottom outlet for operational and safety reasons. The possibility of drawing down the water level rapidly in case of damage to the dam or within the storage area can be very important. In addition it might be necessary, for repair work, to have an additional outlet available during drawdown. In recent years these aspects have been taken into account at many dam projects throughout the world. According to operational characteristics, the size of the dam and its storage volume as well as inflow and outflow quantities, bottom outlets with capacities of up to 500 cu m/second have been constructed. Designers are advised to examine and determine carefully and conscientiously the arrangement and capacity of a bottom outlet. (Baker-IVI)
W86-01690

WATERPROOF ELEMENT FOR EMBANKMENT DAMS,
A. D. M. Penman.
International Water Power and Dam Construction, Vol. 37, No. 7, p 33-36, 41-48 and 112, July, 1985. 17 Fig, 2 Tab, 42 Ref.

Descriptors: *Embankments, *Earth dams, Clay, Concrete, Rolled concrete, Construction, Walls, Membranes, Cutoffs, Dam cores.

The purpose of the waterproof element for embankment dams is to limit the flow of water so that material is not carried away, and so that the downstream drains can cope with the flow to ensure that porewater pressures do not exceed design assumptions. This overview looks at developments in techniques over the years for the construction of the waterproof element for embankment dams. Homogeneous dams, central clay cores (puddled clay cores and rolled clay cores), central core walls (concrete, asphalt, and plastic concrete, upstream membranes (concrete, asphalt, thin sheets), below ground cutoffs (grout curtain, diaphragm walls), and the connection between a dam and an underground cutoff are each discussed. (Baker-IVI)
W86-01691

CONSTRUCTION OF THE RIDRACOLI DAM,
Consorzio Acque per le Province di Forli e Ravenna (Italy).
P. P. Marini, and F. Bavestrello.
International Water Power and Dam Construction, Vol. 37, No. 7, p 52-56, July, 1985. 7 Fig, 2 Tab.

Descriptors: *Ridracoli Dam, *Italy, Dam construction, Rocks, Dam foundations, Sandstone, Rock mechanics, Gravity dams, Arch dams.

The Ridracoli Dam (Italy) is of the concrete gravity-arch type and was completed in the spring of 1982. The dam has a rock foundation of alternating layers of marl and sandstone. The structural and mechanical characteristics of this rock caused problems during excavation as a danger was foreseen of rock layers slipping along the bedding planes. Detailed studies were therefore required, including lab tests, to ensure that stability would not be jeopardized by excavations for the dam. Work on the dam began in 1975 and took about seven years to complete, three of which were spent solely on extensive base excavations. The pouring of the concrete began in the summer of 1978 and was completed in the spring of 1982. The operation to stabilize the excavations and the work of sealing and consolidating the foundation rock were carried out under a sub-contract. (Baker-IVI)
W86-01692

SADD-EL-KAFARA: THE WORLD'S OLDEST LARGE DAM,
Technische Univ. Braunschweig (Germany, F.R.). Leichtweiss-Inst. fuer Wasserbau und Grundbau.
G. Garbrecht.
International Water Power and Dam Construction, Vol. 37, No. 7, p 71-76, July, 1985. 3 Fig, 8 Ref.

Descriptors: *Dam construction, *Sadd-el-Kafara, *Egypt, *History, *Flood control, Design criteria, Flood damage.

The Sadd-el-Kafara dam was investigated in detail for the first time in 1982. The dam was constructed in the era of the Old Egyptian Empire, about 1600 BC, and represents the first attempt at storing water on a large scale. The purpose of the dam was apparently to protect installations in the lower wadi and in the Nile valley from the frequent and sudden floods following heavy rainfalls. The dam, by modern standards, is stable and would have withstood the floods reasonably to be expected if it had been completed. A flood during the construc-

tion period appears to have led to destruction, followed by a catastrophic flood wave. Construction was abandoned. The design was basically correct and the dam was adequately protected from damage caused by water bypassing the dam on the left bank or overtopping. Thus it was a tragedy that an unexpected flood created such a disaster. Even after 4500 years and on the basis of all present day knowledge and experience, the greatest respect must be paid to the Egyptian engineers for having the courage to construct the dam with the limited technological means and scarce scientific knowledge at their disposal. (Baker-IVI)
W86-01693

POWER CONDUITS FOR HIGH-HEAD PLANTS; PART TWO,
Innsbruck Univ. (Austria). Inst. fuer Konstruktiven Wasserbau und Tunnelbau.
G. Seeber.
International Water Power and Dam Construction, Vol. 37, No. 7, p 95-98, July, 1985. 5 Fig, 15 Ref.

Descriptors: *Dam construction, *Power head, *Design criteria, Construction, Dams, Conduits, Pressure tunnels, Shafts, Tunnels, Linings.

The criteria which govern the selection of the technique used to line a power conduit are assessed. The increasing number of high-head storage and pumped-storage schemes built during the past quarter of a century has called for a more critical assessment of the relative benefits of the various methods of lining pressure tunnels and shafts. Applications are given for the following methods: concrete lining plus seal; concrete lining plus thin steel seal; and thickwalled steel linings. In the case of peak load power stations with marked fluctuations in dynamic pressure, special emphasis must be place on engineering and installing the lining with an eye to achieving optimum fatigue strength. In particular, one must take care to avoid notches, sudden changes in thickness, obstacles to expansion, and compound stress. (Baker-IVI)
W86-01695

8B. Hydraulics

FLOW CHARACTERISTICS OF THE HYDRAULIC JUMP IN A STILLING BASIN WITH AN ABRUPT BOTTOM RISE,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, and R. Sinniger.
Journal of Hydraulic Research, Vol. 23, No. 2, p 101-113, 1985. 11 Fig, 17 Ref.

Descriptors: *Hydraulic jumps, *Flow characteristics, *Stilling basins, Hydraulic properties, Fluid mechanics, Jets.

The flow characteristics in prismatic stilling basins with an abrupt rise of the channel bottom are analyzed. Proper accounting for the pressure distribution at the step leads to an expression for the conjugate flow depths in terms of the in flow Froude-number and the relative step height. It is found that the pressure distribution just in front of the step is not hydrostatic but must be augmented by the dynamical pressure head. For a given energy head and Froude-number at the upstream zone of the stilling basin, the dissipated energy is independent of the step height and corresponds to the value of a hydraulic jump on a horizontal bottom. For a given inflow Froude-number, transition between hydraulic jump and jet formation over the step depends on the relative step height. For vertical steps sweeping out and refilling of the stilling basin occurs at identical downstream conditions, whereas downstream flow depth must be higher for refilling when the step is positively inclined. The length of the roller and the jump are slightly longer in stilling basins with positive steps than for ordinary hydraulic jumps on horizontal bottoms. The present study allows a simple and rapid determination of all pertinent design quantities for stilling basins consisting of an abrupt bottom rise. (Baker-IVI)
W86-01391

PREDICTION OF CHARACTERISTICS FOR VERTICAL ROUND BUOYANT JETS IN STABLY LINEAR STRATIFIED ENVIRONMENT,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
W. Li, and C. J. Chen.
Journal of Hydraulic Research, Vol. 23, No. 2, p 115-129, 1985. 9 Fig, 15 Ref.

Descriptors: *Turbulent flow, *Buoyance, *Stratification, *Jets, Model studies, Hydraulic models, Water pollution, Turbulence, Heat flux, Shear stress, Kinetic energy.

The vertical turbulent buoyant jet discharging into a linear stratified environment is one of the most important and basic flow patterns related to environmental pollution. A turbulent model is used to study the behavior of round buoyant jets before the point of neutral buoyancy in stably linear stratified environments. The calculation of the center line velocity, density, turbulent kinetic energy, half-width of buoyancy jets and the profiles of turbulent kinetic energy, turbulent shear stress and turbulent heat flux are made for exit densimetric Froude numbers of 1.0 and 450.0 and strengths of stratification S = 0.0-0.11. A unified scaling law in non-uniform environments is derived for normalization of these results. The correlation of the predicted results shows that the established zone of buoyant jets in the stably linear stratified environment may be similarly divided into three regions for the uniform environment namely non-buoyant region, intermediate region, and plume region. The variation of centerline velocity, density and turbulent kinetic energy along the axial line for both uniform and linearly stratified environments is shown to fall into a single curve under the scaling law derived. The predicted results are compared with the experimental data with fair agreement. The spread of velocity half-width along the axial line for different strengths of stratification in a given exit densimetric Froude number converges to a single curve under the unified scaling law. Unlike the spread of velocity half-width the spread of temperature half-width first spreads and then converges near the established zone for the case of small ambient temperature gradients. For large ambient temperature gradients the spread tends to be convergent. The dimensionless mean velocity profile in the zone of established flow for different exit densimetric Froude numbers and strengths of stratification may be approximated by a Gaussian profile, and the dimensionless mean temperature profile can be expressed in two segments by two Gaussian profiles. The turbulent field does not reach the state of self-similarity at the location closed to the point of neutral buoyance. The predicted results of dimensionless turbulent transport properties are given at two locations for different exit densimetric Froude number. At each location the predicted results are shown to converge into a single curve for different ambient strengths of stratification. (Baker-IVI)
W86-01392

PLANE TURBULENT BUOYANT SURFACE JETS AND JUMPS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and S. Subramanyan.
Journal of Hydraulic Research, Vol. 23, No. 2, p 131-146, 1985. 7 Fig, 1 Tab, 17 Ref.

Descriptors: *Turbulence, *Jets, *Hydraulic jumps, *Fluid mechanics, Richardson numbers, Froude numbers, Buoyance, Surface jets, Entrainment.

Based on an experimental study of plane turbulent buoyant surface jets, the distinction between surface jets and surface jumps has been sharpened. For the surface jet, the growth of the thickness of surface jet in terms of the jet thickness at the outfall with the dimenionless longitudinal distance for a wide range of source Richardson numbers has been evaluated. The structure of the mean velocity in the surface jet has also been studied for a range of Richardson numbers. For surface jumps with supercritical densimetric Froude numbers as large as about 9 there is hardly any entrainment on its lower side. The dimensionless surface profile of the surface jump is the same as that of the more familiar open channel hydraulic jump. The mean velocity field in the surface jump has also been studied. A comprehensive diagram has been developed to predict whether a surface jet, or surface jump or drowned jump will occur for given Richardson numbers and the downstream depth of stratified flow in terms of the source thickness. (Baker-IVI)
W86-01393

IMPACT OF RIVER CHANNELIZATION; II. CHANNELIZATION: SOME ENGINEERING ASPECTS,
North West Water Authority, Warrington (England). Rivers Div.
For primary bibliographic entry see Field 4A.
W86-01402

IMPACT OF RIVER CHANNELIZATION; III. DOWNSTREAM MORPHOLOGICAL CONSEQUENCES OF RIVER CHANNELIZATION IN ENGLAND AND WALES,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 4A.
W86-01403

NUMERICAL ANALYSIS OF KIELDER DAM SPILLWAY,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. Ellis.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 254-270, June, 1985. 15 Fig, 6 Ref.

Descriptors: *Spillways, *Planning, *Kielder Dam, *England, Dam design, Mathematical models, Management, Decision making, Design criteria, Model studies, Computers.

Two different numerical models are described which enable the engineer to assess the effectiveness of alternative spillway arrangements both quickly and economically. The first of these models discussed is used to predict the water surface profiles of the spatially varying flow within the collector channel of a side-discharge weir, for both free and part submerged weir flow conditions. The second model computes the superrelevation of water level on the supercritical flow profile for a steep channel which is curved in plan. The models are used to analyze performance of the Kielder reservoir spillway and comparisons are made with observations undertaken on a physical model of this spillway. Comparisons between computed water surface profiles and physical model observations show good agreement. These findings indicate that numerical models may be used with some confidence in preliminary design of spillways. Primary advantages of the numerical model are its flexibility of application and relative economy of operation. The numerical and physical models are seen as complementary in their roles. Numerical models may best be employed to optimize the main dimensions and alignment of the spillway. Having established the final configuration of the channel the physical model may be used to test the numerical model predicts are refine the design. (Baker-IVI)
W86-01523

EXPERIMENTAL MEASUREMENTS OF MULTIPLE-JET INDUCED FLOW,
Hong Kong Univ. Dept. of Civil Engineering.
J. H. W. Lee, and C. W. Li.
Journal of Engineering Mechanics, Vol. 111, No. 8, p 1087-1092, August, 1985. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Flow mechanics, *Jets, Turbulence, Mathematical equations, Water flow, Shallow water, Water currents.

Basic experimental data on the flow generated by N closely spaced non-buoyant turbulent jets all oriented in the positive x direction into a uniform

coflowing current are reported. The submerged jets discharge close to the bottom of a large receiving water of uniform undisturbed depth, H. The theoretical predictions of the flow induced by a line momentum source in a coflowing shallow water current are satisfactorily corroborated by simple, carefully designed laboratory experiments. The mechanics of such line jet groups in an inclined crossflow is currently under investigation. (Baker-IVI)
W86-01530

CALCULATION OF WAVE DIFFRACTION ON RESERVOIRS OF HYDROELECTRIC AND NUCLEAR POWER STATIONS,
N. N. Zagryadskaya.
Hydrotechnical Construction, Vol. 18, No. 11, p 538-543, November, 1984. 3 Fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 19-22, November, 1984.

Descriptors: *Breakwaters, *Wave diffraction, *Reservoirs, Hydroelectric powerplants, Nuclear powerplants, Waves, Mathematical equations.

Wave diffraction by moles is an essential factor when determining the wave regime on protected water areas. In reservoirs of nuclear and hydroelectric power stations, the role of moles is performed by guide banks. The conventional method (Zhukovets') of calculating wave diffraction on water areas protected by single or convergent moles (breakwaters) is not applicable to cases of protection by offset or overlapping moles when the projection of the width of the inlet is b < or = 0 and secondary deformation occurs. The method is also difficult to use when a successive (repeated) arrangement of the sites of protective structures is encountered. A new method of calculating wave diffraction is presented which is free as far as possible of these shortcomings. Results from the new method are compared with experimentally developed data. The proposed method can be used when solving important practical problems, such as a determination of the wave regime on water areas with a variable depth and with consideration of the spectral structure of the field of initial waves. (Keenan-IVI)
W86-01627

NEW FLOW MODELS CAN HELP SOLVE PUMP-CAVITATION PROBLEMS,
R. Behrens.
Power, Vol. 129, No. 7, p 49-50, July, 1985. 3 Fig.

Descriptors: *Cavitation, *Pumps, *Mathematical models, *Synergetic geometry, Model studies, Flow, Computers,.

Problems in pump cavitation can involve the frequently described classical forms on impeller or casing or less well known localized phenomena. One of the techniques of analysis which can permit construction of flow models that are simultaneously real time, interactive and predictive concerns a relatively obscure branch of mathematics, called synergetic geometry. A computer model of a system with a cavitation problem was created. The volume of water in the space from the low pressure header to the low pressure header was divided into convenient units called DROs. Each DRO received a number and all were observed from a point inside the system, so that they appeared to be stationary. In accordance with the laws of synergetic geometry, the DROs formed into certain patterns. As the pressure, temperature, or velocity changed, their volume changed, and consequently the pattern changed. The computer then identified areas of tetrahelical patterns, in which tetrahedra are joined in corkscrew chains by the sharing of a plane by an adjacent pair of tetrahedra. The computer then identified all patterns upstream of the tetrahelices until it had identified octal flow for a distance of two pipe diameters. The problem then was obvious and steps for a solution were undertaken. A semicircular vane was installed two pipe-diameters upstream of the inlet; with the vane installed, the cavitation and vibration ceased. (Baker-IVI)
W86-01680

VORTEX TOWER FOR THE EL CAJON SPILLWAY INTAKE,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
D. Schulthess.
International Water Power and Dam Construction, Vol. 37, No. 7, p 27-30, July, 1985. 8 Fig, 4 Ref.

Descriptors: *Hydraulics, *Vortex towers, *Intakes, *El Cajon, *Honduras, Spillways, Fluid mechanics, Flow, Model studies.

There is a risk that the gates around the intake zone at the El Cajon Dam, Honduras, could be damaged by the high velocity vortices. With partial gate openings, it is quite likely that logs that have been sucked in by a vortex will cause further damage by colliding with the gates. Further, air bubbles can expand under the gate lips and create instabilities in the uniform flow causing pressure fluctuations with large peaks. Some devices for the prevention of vortex formation have been described earlier. In a way, the vortex tower functions in a similar manner to an injector, and can be used to prevent vortex formation in a large secondary flow region. Tests have been performed with such a vortex tower, and these indicated that vortex formation is able to be controlled for a spillway intake of 1800 cu m/sec capacity. The tower, which has a diameter of 8 m and a height of 20 m, is at present being constructed. At the maximum storage level the tower is submerged by 8.5 m. Flow through the tower accounts for about 10% of the discharge through the spillway. (Baker-IVI)
W86-01689

ENERGY APPROACH TO ESTIMATING SCOUR DOWNSTREAM OF A LARGE DAM,
Vancouver (British Columbia).
K. J. W. Spurr.
International Water Power and Dam Construction, Vol. 37, No. 7, p 81-89, July, 1985. 6 Fig, 3 Tab, 52 Ref.

Descriptors: *Scour, *Estimating, *Dam, Fluid mechanics, Water flow, Design criteria, Plunge pools, Spillways.

The prediction of scour is presented for estimating the equilibrium scour downstream of large dams is necessary to ensure the safety of the toe of the dam as well as stability of its abutments. To assess plunge pool scour accurately, the influence of the spillway layout, the spill duration, the geology and the relative rates of scour developent between the outer pool and the live-scour hole must be taken into account. A rationalized, indexed approach is presented for estimating scour downstream of large dams in terms of the mean surplus jet power and rock threshold energy levels. Although the method proposed could have been more usefully illustrated had the necessary equilibrium spill times, hydraulic and geological data at another large dam been available for checking, this approach offers an advantage over previous procedures. (Baker-IVI)
W86-01694

8C. Hydraulic Machinery

MECHANICAL EQUIPMENT OF THE DNESTER MULTIPURPOSE HYDROPOWER DEVELOPMENT,
M. V. Beketov, Ya. S. Oservaser, and B. A. Fedorov.
Hydrotechnical Construction, Vol. 18, No. 11, p 525-528, November, 1984. 3 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 10-12, November, 1984.

Descriptors: *Mechanical equipment, *Dam construction, *Hydroelectric plants, Cranes, Gates.

The Dnester multipurpose hydropower development located on Dnester River in the Chernovtsy region is intended for power generation, irrigation, water supply, and flood control. The mechanical equipment employed was designed with consideration of its use in the construction period and has a number of distinctive characteristics. The construction of a trestle with the service gantry cranes on the gated wall of the upper pool made it possible to operate the gates before construction was completed, which provided start-up of all units on time. Unlike the traditional designs, these cranes have two-legged portals and the grabs have a sectional construction. This made it possible to reduce the weight by 203 tons. The use of service gates during construction eliminated the construction of additional temporary flashboards and corresponding consumption of metals. The use of structural elements of the concrete-buggy trestle of the Sayano-Shushenkoe hydrostation instead of the earlier specified reinforced-concrete elements of the bridge and crane beams considerably simplified fabrication and shortened the assembly time. The timely design developments for the mechanical equipment in the construction period, correlated to the actual conditions at the construction site, made it possible to accomplish the assembly works in the shortest possible time. (Shieh-IVI)
W86-01624

RESULTS OF INVESTIGATING THE EFFECT OF CAVITATION IN HYDROABRASIVE WEAR OF ELEMENTS OF THE WATER PASSAGEWAY OF AXIAL-FLOW PUMPS,
M. M. Mamazhonov, and A. I. Denisov.
Hydrotechnical Construction, Vol. 18, No. 11, p 544-553, November, 1984. 10 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 22-27, November, 1984.

Descriptors: *Cavitation, *Turbidity, *Pumps, *Abrasion, Hydraulic machinery, Turbines, Suspended sediments, Suction head, Costs.

On-site observation of the operation of hydraulic machines and long experience in operating stations and pumping stations show that abrasive and cavitation-abrasive wear play the main role in the failure of parts of hydraulic turbines and pumps operating on streams with high turbidity. Data is presented which was derived from an experimental facility designed to study the combined effects of cavitation and abrasion due to sediments on failure of hydraulic turbines and pumps. A definite effect of solid particles on the development of cavitation phenomena was found. General principles of selecting the permissible cavitation margin or permissible suction head from the viewpoint of minimum wear rate of pump parts are established. This in turn will impact upon the capital investments required for the construction of pump units. (Keenan-IVI)
W86-01628

NOISE IN THE WATER INDUSTRY,
R. Hobbs.
Water and Waste Treatment, Vol. 28, No. 6, p 10-11, June, 1985. 2 Fig, 1 Tab.

Descriptors: *Noise, *Hydraulic equipment, *Water conveyance, Mechanical equipment, Design criteria,.

There are practical cost effective solutions to combat the problem of noise generated in the water industry due to the movement of water by various mechanical devices. Noise related problems fall into two distinct categories, occupational and involving the employees; and community involving the neighbors. Case studies reveal that even the most difficult projects can be engineered for noise control. These results are not achieved by luck, they are planned for and designed for. When faced with a noise problem whether occupational or community the water authorities can have confidence in the performance of noise reduction and acoustic treatments. (Baker-IVI)
W86-01633

PREVENTING CAVITATION WITH MULTISTAGE ORIFICES,
S. H. Lin.
Hydrocarbon Processing, Vol. 64, No. 7, p 93-95, July, 1985. 2 Tab, 2 Ref.

Descriptors: *Cavitation, *Multistage orifices, Orifices, Erosion control, Water flow, Fluid mechanics, Hydraulics.

A multistage orifice is essentially a series of sharp-edged orifices installed in a line. It prevents cavitation by gradually reducing the pressure. If designed properly, it is highly effective, inexpensive and easy to fabricate when compared to other sophisticated devices. Two types of multistage orifice design are considered. The first type is constant-cavitation index design, and the second is constant-orifice diameter design. The first type of design is to determine the number of orifice stages with such a constant cavitation index so that the given upstream and downstream pressure heads are satisfied. For this case, the pressure drop across an orifice and the orifice diameter will vary from stage to stage. The second type of design utilizes a constant orifice diameter for all orifices and allows the cavitation index to vary. (Baker-IVI)
W86-01721

8D. Soil Mechanics

EFFECT OF LEACHING ON THE INTEGRITY OF A NATURAL CLAY,
McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
For primary bibliographic entry see Field 5E.
W86-01457

PHYSICAL AND CHEMICAL BEHAVIOUR OF CLAY-BASED BARRIERS UNDER PERCOLATION WITH TEST LIQUIDS,
Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Grundbau und Bodenmechanik.
For primary bibliographic entry see Field 5G.
W86-01458

COMPACTION CHARACTERISTICS OF RIVER TERRACE GRAVEL,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
V. K. Garga, and C. J. Madureira.
Journal of Geotechnical Engineering, Vol. 111, No. 8, p 987-1007, August, 1985. 15 Fig, 6 Tab, 12 Ref.

Descriptors: *Compaction, *Gravelly soils, *Construction materials, *Earth dams, *Dams, Permeability, Particle size, Soil types, Soil properties.

Gravelly soils consisting of sound gravel-size particles in a matrix of finer material have proved to be a satisfactory construction material for several large earth dams. The gravel fraction of these soils imparts a relatively high shear strength, high compacted density and low compressibility, while the permeability of the soil is governed by the properties of the matrix material. Large-scale field and laboratory tests were carried out to investigate compaction characteristics of a river terrace gravel soil at the 120-m high Sao Simao Dam in Brazil where approximately 10,000,000 cu m of this material were used as compacted fill. The course fraction of the deposit was typically 3 in. (7.5 cm) maximum size, while the matrix (defined as material passing No. 4 sieve) was basically a clayey sand with LL = 30-35%, PI = 5-15 and 35-50% passing the No. 200 sieve. Field compaction trials were carried out to establish procedures for embankment construction and to evaluate the efficiency of two vibratory rollers. The maximum density for a specific compaction effort was obtained at a gravel content of 65-70%. Shockley's expression for maximum density is not valid for gravel content greater than 25%. The particle size does not significantly affect compaction for gravel content in the 40-60% range for the equipment used in this study. The measured densities are insensitive to the gradation of the gravel fraction. Field compacted density control can be exercised satisfactorily by using elimination and substitution methods: In the substitution method, the plus 3/4 in. fraction size is substituted in a sample by an equal percentage of minus 3/4 in. to plus No. 4 sieve size fraction, and compacted using the intermediate energy; in the elimination method, only the minus 3/4 in. size fraction in a sample is compacted using the standard Procter energy. (Collier-IVI)
W86-01532

REDUCTION OF THE TIME OF PLACING MATERIALS IN THE CONSTRUCTION OF THE DAM AT THE ROGUN HYDROELECTRIC STATION,
T. I. Adam'yants, E. P. Karpoy, and S. Y. Lashchenov.
Hydrotechnical Construction, Vol. 18, No. 11, p 520-525, November, 1984. 4 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 6-9, November, 1984.

Descriptors: *Earth dams, *Dam construction, Rollers, Vibrators, Construction, Earthworks, Construction equipment.

The placement of materials in the dam is the main factor determining the rate of construction in the cyclic production-line technology used for construction of the earth-rock dam at the Rogun hydrostation. Because the geotechnical characters of the materials being used at the Rogun hydrostation are similar to those of Nurek dam, the experience of constructing the dam at the Nurek hydrostation is the basis for recommendations on the parameters and technological operating regimes of vibrating rollers and on the organization of the next investigations for advanced development of the optimal technology for construction of the earth-rock dam at the Rogun hydrostation. To increase the rate and reduce the work time for placing materials in the Rogun dam it is necessary to provide intensive methods of placing the earth materials in layers > 1 m thick with rolling speeds up to 4 km/h and reduction of the number of passes with overlapping by using effective vibrating machines. It is necessary to be oriented mainly towards the use of medium (5-10 tons) and heavy (10-15 tons) mobile vibrating rollers. The parameters and technological operating conditions of the rollers should be refined based on the results of experimental rolling. (Shieh-IVI)
W86-01623

LIQUEFACTION OF FINE SAND DUE TO WAVE ACTION,
Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
L. Zeevaert.
Shore and Beach, Vol. 51, No. 2, p 32-36, April, 1983. 6 Fig.

Descriptors: *Liquefaction, *Sand, *Waves, *Grijalva River, *Mexico, Erosion, Jetties, Clay, Subsidence, Sediment transport, Erosion.

In connection with an investigation for the construction of two new long jetties at the mouth of the Grijalva River in order to permit safe navigation to reach the Port of Frontera in the State of Tabasco, Mexico, liquefaction in fine sand was also studied. Subsoil investigations indicated a surface deposit of about 5 mts thick of the fine sand with a mean diameter ranging between 0.15 and 0.20 mm. From 10 to 29.5 mts depth a thick bluish-gray clay deposit with microscopic shells was encountered and is underlain by gray silty snd with small shells. The average water content of the clay deposit is about 55% and is practically constant with depth. The shearing strength of the clay deposit, between 10 and 29.5 mts depth, was obtained from unconfined compression tests and showed an erratic value, probably because of the strong difference in the salinity of the water during the process of sedimentation and flocculation of the fine grains. The large subsidence of the rock jetties found may be attributed only to the simultaneous action of spontaneous liquefaction and base erosion. Instantaneous liquefaction may be visualized as a pumping action produced by the waves in the fine sand at the toe of the jetty, permitting a gradual subsidence of the rock into the sand up to a depth where the effective stress in the sand is greater than zero. The water flow at the foundation grade elevation of the jetty facilitated the transport of the fine sand, permitting the spreading of the rock slope of the jetty because of the reduction in the foundation support. (Baker-IVI)
W86-01845

8E. Rock Mechanics and Geology

RESULTS OF EXPERIMENTAL DRILLING AND BLASTING OPERATIONS IN PREPARING THE ROCK FOUNDATION OF THE KRAPIVINSKII HYDROELECTRIC STATION,
A. E. Azarkovich, and V. N. Yanovskii.
Hydrotechnical Construction, Vol. 18, No. 11, p 529-533, November, 1984. 3 Fig, 3 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 12-15, November, 1984.

Descriptors: *Blasting, *Foundation rocks, *Dam construction, Dam foundations, Hydroelectric plants, Foundations, Blasthole charges.

Drilling and blasting operations near the lower contour of the foundation pits of important hydraulic structures should be performed so that the necessary preservation of the rock foundation is provided. A new method of calculating the parameters for blasting is evaluated. The objective of the new method is to allow loosening of the layer of rock directly above the foundation contour by reduced blasthole charges rather than by shothole charges. The suitability of the new method was confirmed by blasting at the Krapivinskii hydrostation. The methods of investigation used did not show disturbance of the foundation after the blasts. (Keenan-IVI)
W86-01625

8F. Concrete

PERFORMANCE OF WATER PIPELINE MATERIALS,
R. L. Klein, and A. J. Rancombe.
Chemistry and Industry, Vol. 11, p 353-358, 1985. 15 Ref.

Descriptors: *Pipelines, *Water supply, *Water distribution, *Cement, Construction materials, Concrete, Corrosion, Iron, Bacteria, Joints.

The performance of the principal materials in general use for water supply pipelines has been reviewed. It will be evident that no single material is without its shortcomings and that, despite considerable advances in technology, the hazards associated with each material remain imperfectly understood, as do the most appropriate methods of overcoming them. Ductile iron is an excellent material which in most circumstances can be expected to give long and trouble-free service. But, instead of the half measures of zinc spraying and polyethylene sleeving, the industry should be looking at a more durable method of coating. Cement mortar lining will in most cases last as long as the pipe, but may be vulnerable to very soft waters. Perhaps fusion bonded epoxy or some similar plastic system will in the future take the place of present methods of protection. Steel pipe, generally the only material appropriate to high pressure transmission mains, is unsuitable for distribution purposes for two reasons: the full strength of the material is not utilized at low pressures and the pipe is therefore uneconomical. Secondly, the application of cathodic protection is impracticable in an urban environment because of interference with other services. Both prestressed concrete amd asbestos cement pipes will give good long term service in most circumstances, but it is disappointing that manufacturers have not applied themselves more diligently to developing protective coatings which will guarantee performance in environments corrosive to cement. (Baker-IVI)
W86-01611

WAYS TO IMPROVE THE TECHNOLOGY OF CONSTRUCTING CONCRETE HYDRAULIC STRUCTURES,
A. D. Osipov.
Hydrotechnical Construction, Vol. 18, No. 11, p 517-520, November, 1984. 1 Tab, 1 Ref. Translated

from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 4-6, November, 1984.

Descriptors: *Hydraulic structures, *Concrete technology, Arch dams, Dam construction, Rolled concrete, Retaining walls, Reinforced concrete, Concrete additives.

A number of measures have been taken recently in the construction of high arch dams in order to ensure a high-strength concrete and solidity of the concrete masonry. However, the implementation of these measures significantly increases the cost of concrete masonry of a dam. Several new approaches can be taken to reduce the cost, construction time, and labor expenditures associated with the construction of concrete dams. When constucting dams, retaining walls, and other massive structures it is possible to use a very stiff low-cement rolled concrete (80-100 kg/cu m) placed in thin layers on a large area. The use of such concretes in dam construction makes it possible to eliminate both the frequent sectionalizing into blocks and other measures for controlling thermal stresses. All thin-walled reinforced-concrete structures should be made of poured self-compacting concrete mixes delivered by concrete pump with the use of plasticizing and air-entraining additives, which will make it possible to have the required physical and mechanical properties of concrete without the overconsumption of cement. Stiff fine-grained concrete mixes placed and compacted by rotary throwers or vibrating rollers should be used for revetting the slopes of earth structures. (Shieh-IVI)
W86-01622

8G. Materials

HYDRAULIC CONDUCTIVITY OF TWO PROTOTYPE CLAY LINERS,
Geo-Con, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5G.
W86-01531

PROTECTIVE COATINGS FOR WATER STORAGE TANKS AND WATER TREATMENT FACILITIES,
Mobil Chemical Co., Edison, NJ.
T. P. Delany, and J. Zawacki.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 164-186, June, 1985. 8 Ref.

Descriptors: *Water storage tanks, *Water treatment facilities, *Coatings, Requirements, Specificiations, Water tanks.

A good protective coating job requires the teamwork of several people, the engineer, the applicator, the coatings manufacturer, and the inspector. Some of the many considerations regarding the selection and use of protective coatings in water treatment and storage facilities are presented. Specific areas considered include: a properly written painting specification, surface preparation, proper inspection, and paint systems. (Baker-IVI)
W86-01753

8I. Fisheries Engineering

EFFECTS OF ANNUAL DRAINING ON WATER QUALITY AND PRODUCTION OF CHANNEL CATFISH IN PONDS,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
W. D. Hollerman, and C. E. Boyd.
Aquaculture, Vol. 46, No. 1, p 45-54, May, 1985. 5 Fig, 4 Tab, 16 Ref.

Descriptors: *Aquaculture, *Catfish ponds, *Ponds, *Draining, *Fish farming, Catfish farming, Water quality, Chlorophyll a, Phosphorus, Chemical oxygen demand, Nitrates, Nitrites, Ammonia, Nitrogen.

Concentrations of chlorophyll a, total phosphorus, chemical oxygen demand, nitrite-nitrogen, total ammonia-nitrogen, and dissolved oxygen were measured frequently in channel catfish ponds, of which four were drained annually and four were not drained for 3 years. Average concentrations of total phosphorus increased from year to year in undrained ponds, and they were higher ($P < 0.01$) in undrained ponds than in drained ponds during the second and third years of the study. Phytoplankton abundance, as evident from chlorophyll a concentrations, did not differ ($P > 0.05$) within or between treatments during the 3 years. Water quality was similar between treatments. One difference in production of channel catfish occurred during the third year and was related to a parasite infection of fish rather than water quality. The findings suggest that the recent trend in not draining channel catfish ponds at harvest will not lead to rapid deterioration of water quality in ponds. (Author's abstract)
W86-01322

SETTING OF THE AMERICAN OYSTER CRASSOSTREA VIRGINICA IN THE JAMES RIVER, VIRGINIA, USA: TEMPORAL AND SPATIAL DISTRIBUTION,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W86-01504

FACTORS AFFECTING GROWTH AND RECRUITMENT OF YELLOW PERCH, PERCA FLAVESCENS MITCHILL, IN SOUTH BAY, LAKE HURON,
Ontario Ministry of Natural Resources, Toronto. Lake Huron Fisheries Research Unit.
B. A. Henderson.
Journal of Fish Biology, Vol. 26, No. 4, p 449-458, April, 1985. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Perch, *Lake Huron, *Recruitment, *Growth, Lakes, Population dynamics, Water temperature, Water level, Fish populations.

Several hypotheses were tested which explain the large variations in recruitment and growth observed in yellow perch. The five hypotheses are: recruitment is positively correlated with water temperature; recruitment is a function of parental stock-size; recruitment is a function of water levels; growth is related to population abundance; and growth is dependent upon water temperature. The ratio of recruits to spawners was principally determined by variations in water levels, which presumably reflected the effect of variations of the quality and quantity of spawning substrates on egg or fry survival. The recruitment was then dependent upon the combination of stock-size and the survival of the eggs or fry. Thus, good recruitment could only be achieved if a large parental stock size produced eggs that survived well. In recent years, the parental stock-size in South Bay was small, but the survival was good; as a result, the recruitment was relatively poor compared with the earlier years when both parental stock-size was large and early survival was high. There was no indication that recruitment and the ratio of recruits to spawners was dependent upon stock density; therefore, a stock-recruitment relationship did not exist. Variations in R/P were a function of water levels and not parental stock-size. Growth was not dependent upon water temperatures, but was affected by population abundance. The number of recruits, and not the total population size determined the rate and increment of growth. The implication is that competition for food takes place between perch of a similar size and age. The environment determined the ratio of recruits to spawners, and the population size affected growth. (Baker-IVI)
W86-01508

ESTIMATING THE POPULATION DYNAMICS OF COHO SALMON (ONCORHYNCHUS KISUTCH) USING POOLED TIME-SERIES AND CROSS-SECTIONAL DATA,
Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 2H.
W86-01585

WATER TEMPERATURE AS THE PRIMARY INFLUENCE ON TIMING OF SEAWARD MIGRATIONS OF ATLANTIC SALMON (SALMO SALAR) SMOLTS,
Direktoratet for Vilt og Ferskvannsfisk, Sandnes (Norway). Forskningsstasjion for Ferskvannsfisk.
For primary bibliographic entry see Field 2H.
W86-01589

RESERVOIR FISHERY RESEARCH NEEDS AND PRIORITIES,
Tennessee Valley Authority, Chattanooga.
G. E. Hall.
Fisheries, Vol. 10, No. 2, p 3-5, March-April, 1985. 17 Ref.

Descriptors: *Fisheries, *Management, *Reservoir fisheries, Operation, Planning, Reservoir operation, Fish stocking, Water quality, Surveys, Research priorities.

In surveys conducted in 1983 and 1984 approximately 80 professional fisheries biologists with reservoir experience were asked to furnish information and ideas on gaps in current reservoir knowledge, pressing needs for additional information, appropriate directions for research and the kind of organization best suited to conduct a reservoir fisheries program. Knowledge gaps identified by the largest number of respondents in both surveys were: the absence of a clear understanding of predator/prey interactions; need for information on optimum stocking procedures; knowledge of factors affecting the recruitment of fish; and information concerning impacts of harvest regulations on individual species and population balance. Highest priorities for needed information concerned a better knowledge of water quality/fish interactions and the ability to predict impacts of reservoir drawdowns and/or water level fluctuations plus more information on proven reservoir management techniques. The majority of respondents thought the development of models for managing reservoir problems should receive the greatest attention. Over 90% of the survey respondents considered reservoir research to be a federal responsibility. Although most of the respondents felt that reservoir research was a federal responsibility deserving national attention, there is a lack of concensus concerning how it should be funded and administered. (Baker-IVI)
W86-01598

MANAGEMENT OF LACUSTRINE FISHERIES IN THE TROPICS,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
R. T. Oglesby.
Fisheries, Vol. 10, No. 2, p 16-19, March/April, 1985. 2 Tab, 15 Ref.

Descriptors: *Fish management, *Reservoirs, *Tropical regions, Resources management, Fish populations, Fisheries, Developing countries, Regional development.

Lake and impoundment fisheries of many developing countries have the potential to provide accessible, relatively inexpensive animal protein in quantities approaching a hundred kilograms per hectare of surface per year. These fisheries in the lowland tropics currently yield an average catch of 80 kg/ha/hr. There are two kinds of harvest limitations: those imposed by constraints on fish production and those resulting from underdevelopment of fisheries. A first, critical step in the management of these fisheries is to predict potential yields and to compare them with current harvests. Site specific management programs can then be developed by taking into account stocking, assistance to fishermen, data collection and analysis, and program evaluation. Most impoundments now being built or planned in developing countries are primarily for the production of power and the storage of water for crop irrigation. Fisheries are an add-on and their management becomes complicated by the presence of trees not removed during site preparation and extreme water level fluctuations that occur both seasonally and between years. Inclusion of fishery personnel in making operation decisions as well as in initial planning activities may result in substantially improved fishery development oppor-

tunities. Management of lake and impoundment fisheries in developing tropical countries is at an early stage but seems to be evolving rapidly. (Collier-IVI)
W86-01600

9. MANPOWER, GRANTS AND FACILITIES

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For primary bibliographic entry see Field 5D.
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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

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N01	45.00
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E01	$7.50
E02	10.00
E03	11.00
E04	13.50
E05	15.50
E06	18.00
E07	20.50
E08	23.00
E09	25.50
E10	28.00
E11	30.50
E12	33.00
E13	35.50
E14	38.50
E15	42.00
E16	46.00
E17	50.00
E18	54.00
E19	60.00
E20	70.00
E99	*

T01	$145.00
T02	160.00
T03	275.00
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T05	460.00
T06	535.00
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